A REVISION OF THE LAKE VICTORIA *HAPLOCHROMIS* SPECIES (PISCES, CICHLIDAE)

PART V

BY

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Pp. 139–214 ; *Plate* 1 ; 25 *Text-figs.*

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CONTENTS

INTRODUCTION

This paper is one of two dealing with the piscivorous *Haplochromis* of Lake Victoria. In this part, I have tried to consider a representative sample of species which cover the different morphological types in this trophic group. A species that I consider to represent a morphological type from which the fish-eating species could have evolved, is also described.

Haplochromis brownae sp. nov.

Text-figs. 1 and 25

Haplochromis stanleyi (part) Boulenger, 1915, *Cat. Afr. Fish.* **3**, 295 (one specimen B.M. (Nat. Hist.) Reg. No. 1909.5.4.28; collected by Bayon in the Sesse Islands; apparently this specimen was not considered by Regan in his revision of 1922).

Paratilapia guiarti (part): Boulenger, 1915, *op. cit.* **3**, 336 (one specimen B.M. (Nat. Hist.) Reg. No. 1906.5.30.354).

Haplochromis guiarti (part): Regan, 1922, *Proc. zool. Soc. London*, 174 (the same specimen as above).

Holotype: A specimen 104·0 mm. S.L. from Entebbe; B.M. Reg. No. 1906.5.30.354.

Description. Based on forty-nine specimens (including the holotype) 72–104 mm. standard length.

Depth of body 32·2–39·8 (mean, M, 35·1) per cent of standard length, length of head 30·2–33·4 (M = 31·6) per cent. Dorsal profile of head straight or slightly concave above the eyes, sloping at about 45°.

Preorbital depth 13·8–19·4 (M = 16·3) per cent of head, least interorbital width 26·0–34·0 (M = 29·8) per cent. Snout as long as broad or very slightly broader, its length 28·0–33·3 (M = 30·8) per cent of head; eye diameter 26·0–31·3 (M = 28·6), depth of cheek 18·9–25·9 (M = 22·7) per cent.

Caudal peduncle length 14·6–20·4 (M = 17·6) per cent of standard length, 1·3–1·8 (mode 1·6) times as long as deep.

Mouth horizontal or slightly oblique, the jaws equal anteriorly, the lips not thickened. Length of lower jaw 38·0–42·9 (M = 40·3) per cent of head, 1·7–2·1 (mode 2·0) times as long as broad. Posterior tip of the maxilla reaching or almost reaching the vertical through the anterior orbital margin.

Gill rakers 9–12 (modal numbers 10 and 11) on the lower part of the first gill arch, the lowermost two to five rakers short and stout, the remainder usually slender (specially in fishes with more than ten rakers) but occasionally stout.

Scales ctenoid; lateral line with 30 (f.1), 31 (f.5), 32 (f.32) or 33 (f.11) scales. Cheek with 2 or 3 imbricating rows. Six or 7 (rarely 8) scales between the lateral line and the dorsal fin origin, 6–8 (modes 7 and 8) between the pectoral and pelvic fin bases.

Fins. Dorsal with 22 (f.1) 24 (f.4), 25 (f.37) or 26 (f.7) rays, comprising 13 (f.1), 14 (f.1) 15 (f.18) or 16 (f.29) spinous and 8 (f.1), 9 (f.24) or 10 (f.24) branched rays. Anal with 11 (f.4), 12 (f.42) or 13 (f.3) rays, comprising 3 spinous and 8–10 branched rays. Caudal truncate, scaled on the basal half only. Pectoral fin from slightly shorter than, to as long as the head, 24·4–33·4 (M = 28·8) per cent of standard length.

Teeth. In most specimens the outer row in both jaws is composed of relatively stout and bicuspid teeth, but in many fishes (irrespective of size) the posterolateral teeth in the upper jaw are unicuspid or tricuspid. In a few specimens there is an admixture of bi- and unicuspid teeth anteriorly in both jaws. There are 50–66 (M = 56) teeth in the upper, outer series.

Teeth in the *inner rows* are tricuspid and arranged in 2 or 3 (rarely 4) series in the upper jaw and 1 or 2 series in the lower jaw.

Osteology. The neurocranium is that of a generalized *Haplochromis.* The supraoccipital crest slopes fairly steeply and is moderately deep ; the ethmoidal region slopes fairly steeply and the vomer is curved ventrally. The preotic part of the skull is 55–58% of the basal length (as measured from the tip of the vomer to the posterior rim of the basioccipital). The lower *pharyngeal* bone is slender, the teeth cuspidate and fine, without markedly enlarged teeth in the median rows. The dentigerous surface is as broad as it is long and there are 34–40 rows (counted antero-posteriorly) of teeth.

Number of vertebrae : 29 (f.2), 30 (f.9) or 31 (f.3), comprising 12 (f.1), 13 (f.4) 14 (f.8) or 15 (f.1) precaudal and 16 (f.8) or 17 (f.6) caudal elements.

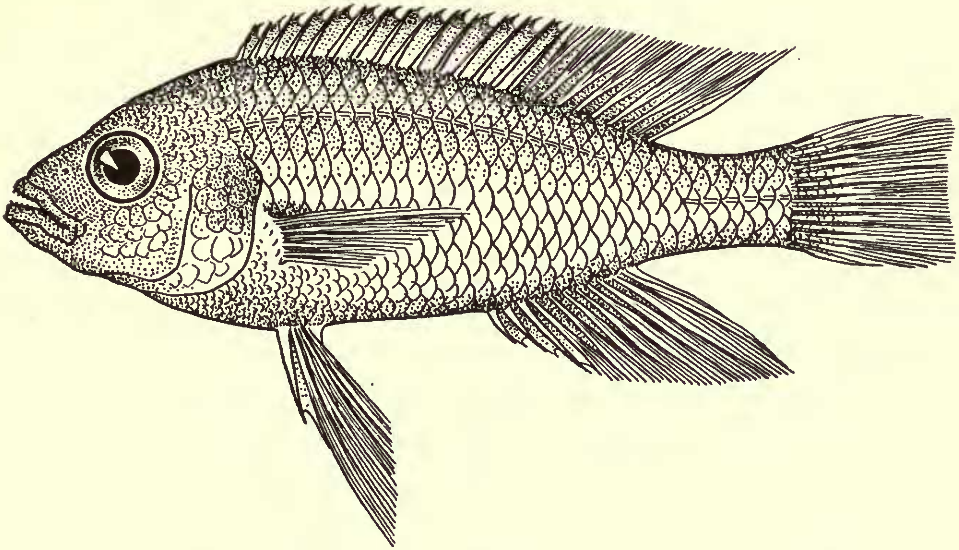

FIG. 1. *Haplochromis brownae* ; natural size. (Drawn by Lavinia Beard.)

Coloration in life. Adult males. Ground colour grey-green dorsally, shading to silver-blue ventrally ; snout dark grey-green. In sexually active fishes a carrot-orange flush develops on the cheek, operculum, flanks and belly ; in such fishes there is also a pronounced lachrymal stripe. Dorsal, caudal and anal fins sooty-grey, the dorsal with three to five horizontal rows of ruddy spots between the spines and rays ; anal ocelli (usually a single row of three or four) orange. Pelvic fins black.

Females have a silver-grey ground coloration (lighter than that of the males) shading to silver ventrally. All fins are hyaline, except the pelvics which are light lemon-yellow. In some individuals there are small orange spots in the position of the anal ocelli in males.

Colour of preserved material. Females. Brownish above, silvery below and on the cheek ; a faint lachrymal stripe is visible as are five transverse bars on the flanks, none of which reaches the ventral profile ; in some specimens there is a short dark, midlateral streak situated above the anal fin. All fins are colourless. In *males* the coloration is more variable, some fishes having a female type coloration (see above) but with a more intense lachrymal stripe and a distinct vertical postorbital bar. All fins, except the pelvics, are hyaline, the dorsal with dusky lappets ; the pelvics are dark laterally but greyish medially.

Other specimens have a similar coloration but the ground colour is darker, the pectoral region sooty and the pelvic fins entirely black. These differences may be associated with the fish's sexual state.

A third varient (undoubtedly attributable to differences in the mode of preservation) almost resembles the live colours. Here the belly, operculum and cheek still retain traces of the carroty flush, the transverse bars are very faint, the lachrymal stripe is intense and the dorsal fin distinctly maculate. The pectoral region is dusky and the pelvic fins are black.

Distribution. Known only from Lake Victoria.

Ecology. Habitat. The species is confined to sandy or shingle beaches where the water is less than thirty feet deep ; such areas are always relatively or completely exposed to wave action. No specimens have been recorded from areas where the substrate is soft.

Food. Twenty of the fifty specimens examined contained ingested material. Of these, three had fed on small fishes (two specimens exclusively so and one on adult termites as well) tentatively identified, in one case, as *Engraulicypris argenteus*, but unidentifiable in the others. Since all three fishes are males the possibility of the fishes having swallowed their own young is eliminated.

The food from the seventeen other fishes is very varied, but it does seem that *H. brownae* is predominantly insectivorous. Larval and pupal Diptera are the commonest foods, but after heavy termite hatches the food can become exclusively winged termites. Other common materials from the gut are macerated fragments of plant tissue and colonial blue-green algae (cf. *Rivularia*). Neither plant shows any signs of digestion. Sand grains and bottom debris are infrequent. Since large numbers of *Rivularia* colonies are often broken away from their substrates after heavy swells, it is possible that the fishes snap up the floating masses as they drift past. Similar concentrations of colonial blue-greens have been found in the guts of other *Haplochromis* whose usual feeding habits do not involve feeding from the bottom. Certainly plants can contribute little to the diet of *Haplochromis brownae* because plant material is apparently indigestible.

Breeding. The species is a female mouth brooder ; the smallest specimen available (72 mm. S.L.) is brooding. Both sexes seem to reach the same maximum adult size.

Affinities. Structurally, and in its diet, *H. brownae* is a generalized lacustrine *Haplochromis*. It differs, however, from the other generalized and insectivorous species of Lake Victoria in having a high number of gill rakers (9–12 *cf.* 6–9) ; in fact very few Victoria species of any structural or trophic group have more than ten rakers. In most other characters *H. brownae* is very similar to *H. melanopus*, another littoral insectivore with similar ecology. The two species do, however, differ in the shape of the lower pharyngeal bone and its dentigerous surface. In *H. melanopus* the toothed area is clearly broader than long, whereas in *H. brownae* the area is equilateral, or almost so. The species also differ markedly in the colours of the breeding male.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.354 (Holotype)	Entebbe	Degen
,, 1909.5.4.28	Sesse Isls.	Bayon
,, 1911.3.3.22	Jinja, Ripon falls	,,
,, 1962.3.2.96–7	Grant Bay	E.A.F.R.O.
,, 1962.3.2.109–113	Beach near Nasu pt.	,,
,, 1962.3.2.114–9	Buka Bay	,,
,, 1962.3.2.120–7	Entebbe Harbour	,,
,, 1962.3.2.128	Beach near Nasu pt.	,,
	Tanganyika	
,, 1962.3.2.76–88	Mwanza, Capri Bay	,,
,, 1962.3.2.89–95	Majita Beach	,,
,, 1962.3.2.98–108	Beach near Majita	,,

Haplochromis guiarti (Pellegrin) 1904

Text-figs. 2 and 25

Tilapia guiarti Pellegrin, 1904, *Bull. Soc. zool. France*, **29**, 186 ; *Idem.*, 1905, *Mem. Soc. zool. France*, **17**, 184, pl. 16, fig. 1.
Paratilapia guiarti (part) : Blgr., 1915, *op. cit.*, **3**, 334 (not the figured specimen).
Paratilapia victoriana (part) : Boulenger, 1915, *op. cit.*, 341 (one specimen, B.M. (Nat. Hist.) Reg. No. 1906.5.30.281).
Haplochromis cinereus (part) : Regan, 1922, *Proc. zool. Soc. London*, 166 (specimen noted above).
Haplochromis guiarti (part) : Regan, 1922, *op. cit.*, 174.
Haplochromis nigroventralis Lohberger, 1929, *Akad. Anz. Wien.*, **66**, 207.

Specimens included in Regan's (1922) synonymy as *Tilapia perrieri* and *Paratilapia longirostris* are no longer considered to be specimens of *H. guiarti*. In his synonymy Regan also included part of *Tilapia pallida* (Boulenger, 1915 *Cat. Afr. Fish.* **3**, 232). Despite an extensive search, I cannot find any specimens referred to this species which Regan might have examined. For this reason I have not included *T. pallida* (part) in my synonymy.

Holotype. A female 114 mm. S.L. (Paris Museum No. 04 × 150) from the Kavirondo Gulf, Kenya.

Description. Based on fifty-five specimens (83–177 mm. S.L.) including the holotype of the species and that of *H. nigriventralis*. All these fishes came from Lake Victoria (see below, p. 147).

Depth of body 27·3–36·5 (M = 32·3) per cent of standard length, length of head 29·5–33·8 (M = 31·4) per cent. Dorsal profile of head slightly curved and sloping at an angle of *ca* 40°–45°.

Preorbital depth 16·3–21·5 (M = 18·3) per cent of head, least interorbital width 23·4–30·2 (M = 27·4) per cent. Snout longer than broad, or, rarely, as long as broad, its length 31·7–37·5 (M = 34·4) per cent of head. Eye diameter shows slight negative allometry with standard length, being 23·6–29·8 (M = 26·5) per cent in fishes < 115 mm. S.L. (N = 16) and 19·7–25·3 (M = 22·0) in larger individuals (N = 39). Depth of cheek shows very slight positive allometry, 20·0–29·0 (M= 25·9) per cent of head for the whole sample.

Caudal peduncle 16·2–20·8 (M = 18·9) of standard length, 1·4–2·0 (mode 1·5) times as long as deep.

Mouth slightly to moderately oblique, the jaws equal anteriorly. Length of lower jaw 39·2–48·2 (M = 44·4) per cent of head, 1·5–2·3 (mode 2·0) times as long as broad. Lips not thickened, the posterior tip of the maxilla not quite reaching the vertical through the anterior orbital margin in most fishes but reaching this point in a few. The dentigerous arm of the premaxilla shows no medial antero-posterior lengthening.

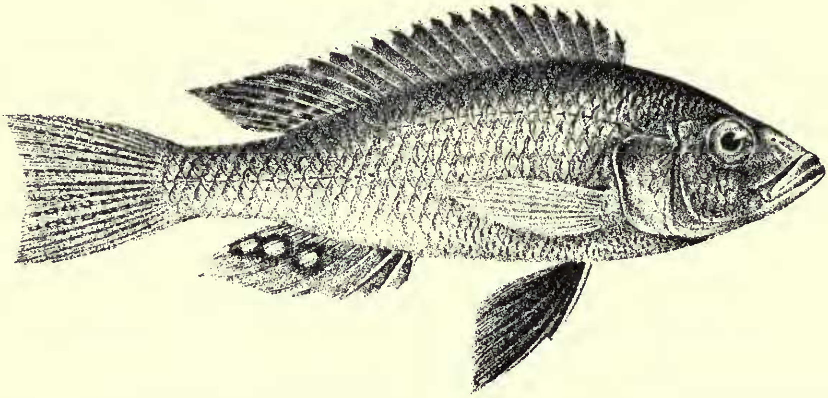

FIG. 2. *Haplochromis guiarti* ; about ½ × N.S. (From Boulenger, *Fish. Nile.*)

Gill rakers moderately stout but not stubby ; 9–11 (mode 10) on the lower part of the first arch, the lowermost 1–3 rakers reduced.

Scales ctenoid ; lateral line with 32 (f.2), 33 (f.26), 34 (f.18), 35 (f.7) or 37 (f.1) scales. Cheek with 3 (less commonly 4 and rarely 2) imbricating rows. Six or 7 (rarely 5, 5½ or 8) scales between the lateral line and the dorsal fin origin ; 6 or 7 (rarely 8 or 9) between the pectoral and pelvic fin bases.

Fins. Dorsal with 25 (f.35), 26 (f.19) or 27 (f.1) rays, comprising 15 (f.12), 16 (f.41) or 17 (f.2) spinous and 9 (f.25), 10 (f.29) or 11 (f.1) branched rays. Anal with 11–13 rays, comprising 3 spinous and 8–10 (mode 9) branched rays ; in one exceptional specimen there are 4 spines and 9 rays. Caudal truncate, pelvics (particularly in adult males) with the first two branched rays elongated but rarely extending to beyond the first or second branched anal ray (cf. *H. bayoni* where these pelvic rays are greatly produced). Pectoral fin 21·2–27·4 (M = 25·0) per cent of standard length.

Teeth. In fishes <115 mm. S.L. the anterior teeth of the outer row in both jaws are usually unicuspid whilst the lateral teeth are slender and bicuspid. The majority of fishes >115 mm. S.L. have all the outer teeth unicuspid, relatively slender and slightly incurved. However, in several specimens the posterolateral teeth (especially in the upper jaw) are slender and bicuspid or weakly bicuspid. There are 48–74 (M = 62) teeth in the outer row of the upper jaw, the number showing a weak positive correlation with standard length.

In most fishes of all sizes the *inner* teeth are tricuspid but it is not uncommon to find a mixture of tri- and unicuspid teeth, the former predominating. Fishes with the entire inner series composed of unicuspids are rare even amongst specimens >150 mm. S.L. The inner teeth are implanted obliquely and arranged in 3 or 4 (less frequently 2 or 5, rarely 7) rows in the upper jaw and usually in 2 (less commonly 1, 3 or 4) rows in the lower jaw. It seems likely that the number of inner tooth rows is positively correlated with size since there is a tendency for fishes over 125 mm. S.L. to have the higher numbers of rows. Only one fish has seven premaxillary rows (it is a large specimen [170 mm. S.L.] but not the largest) ; the arrangement of these teeth is very irregular and suggests some ontogenetic disturbance.

Osteology. The neurocranium of *H. guiarti* can be considered as a basic type amongst the piscivorous species. Although it shows several characteristics of the " extreme " predator skull (see p. 209) in an early phase of development, it also shows affinity with the generalized *Haplochromis* skull type as seen, for instance, in *H. brownae*. These points are discussed on pages 207–9.

Vertebrae. Thirty or 31, comprising 13 or 14 precaudal and 16–18 caudals. (Based on six specimens.)

Lower pharyngeal bone fine, its dentigerous surface equilateral or somewhat broader than long. The teeth are cuspidate and slender, the most posterior two or three teeth of the two median rows are generally enlarged ; there are 22–28 (mode 26) rows of teeth.

Coloration in life. *Adult males*. Dorsal surface of head and body intense malachite green shading ventrally to silver. All fins colourless except the pelvics which are black, and the caudal which is dark ; anal ocelli (3 or 4 in a single row) bright orange. *Females* have similar coloration except that the pelvics are light yellow and the anal ocelli are absent or represented by small orange spots. After death the colours change rapidly to dark grey-black above and silver below.

Colour in preserved material. *Adult males*. Ground colour greenish-grey overlying silver, chest and belly sooty ; a dark lachrymal stripe is generally present. Dorsal fin sooty, the lappets darker and with a small hyaline area between each lappet ; caudal dark on the proximal two-thirds, hyaline distally. Anal fin greyish, the ocelli darker grey ; pelvics black. *Sexually quiescent* males have a female type of coloration but with the transverse bars fainter and the anteroventral part of the body sooty. The dorsal fin is sooty, with black lappets ; the caudal is maculate, the anal hyaline and the pelvics black. *Adult females* are dark grey dorsally, greyish-silver below and becoming silvery-white on the chest and belly. Often there are traces of six transverse bars of lengths varying from short to almost the full depth of the body ; sometimes these bars are connected by a fainter longitudinal stripe. All the fins are hyaline, the caudal often maculate on its proximal half to two-thirds.

Distribution. Lake Victoria and Lake Edward. I have examined three specimens from the latter area. The fishes seem to be referable to *H. guiarti* but I await further material before confirming the occurrence of the species in Lake Edward.

Ecology. Habitat. The species has a lake-wide distribution but is confined to sand or shingle beaches where the water is less than 20 ft. deep. No specimens have been taken over a soft substrate. Information on the distribution and feeding habits of *H. guiarti* given by Graham (1929) must be discounted because several species were confused under this name in his report.

Food. The material found in the alimentary tract of *H. guiarti* may be divided, in order of abundance, into three groups: (1) Fishes (particularly small cichlids) (ii) Insects (particularly winged Termites [Isoptera] and chironomid pupae [Diptera], less frequently larval *Povilla adusta* [the boring may-fly]) (iii) Fragments of phanerogam tissue associated with the colonial blue-green alga *Rivularia*.

Basing the estimate on both frequency of occurrence and on volume, the difference between the amount of fish and the amount of insect food eaten is not great nor is it correlated with the size of the fish. It is difficult to assess the nature of insect-eating habits in this species. At one locality where seine hauls were carried out regularly, it was possible to associate the habit with any high level of insect activity. In this particular case insect-eating might be considered a faculative response to a sudden abundance of a readily available food. The simultaneous occurrence of other species also gorged with the same insects (particularly when the usual diet of these fishes was not primarily insects) seems to indicate that many *Haplochromis* species are " opportunistic " in their feeding habits.

None of the plant matter showed signs of digestion and cannot thus be considered as " food ". As in the case of *H. brownae* (see p. 144) the material may have been accidentally ingested.

In general, the food and feeding habits of *H. guiarti* are similar to those of *H. brownae*. The principal difference lies in the greater proportion of fish eaten by *H. guiarti*.

Breeding. Haplochromis guiarti is a female mouth-brooder; brooding females are found in the same habitat as non-breeding individuals. Sexual maturity is reached at a length of about 100 mm. although some individuals of 110–113 mm. are still immature. There is no marked sexual dimorphism in adult size.

Affinities. Perhaps the nearest living relative of *H. guiarti* is *H. brownae*. The species differ in many respects but the divergence of *H. guiarti* lies in those anatomical (and associated morphometric) characters which we find in a more exaggerated condition amongst the entirely piscivorous predatory species. The resemblance between *H. guiarti* and *H. brownae* is most apparent in young specimens (80–90 mm. S.L.) of the former and adults of the latter species (70–90 mm. S.L.), but even at this size *H. guiarti* is distinguishable on certain characters (longer jaws and snout) which are part of the " predatory species " character complex. However, it is possible that *H. guiarti*, itself still a relatively generalized species amongst the predators, evolved from an *H. brownae*-like stem.

Amongst the larger predatory species, *H. guiarti* is perhaps related to *H. squamulatus*; but the overall resemblance is less than that between *H. guiarti* and *H. brownae*. Another species with about the same degree of relationship as *H. squamulatus* is *H. bayoni* (see p. 152).

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.210–2	Entebbe	Degen
,, 1906.5.30.213–5	,,	,,
,, 1906.5.30.220–8	,,	,,
,, 1906.5.30.230	Nsonga	,,
,, 1906.5.30.281	Entebbe	,,
,, 1906.5.30.355–361	Entebbe	,,
,, 1909.5.4.6–7	Sesse Isls.	Bayon
,, 1928.1.25.22	Entebbe	Pitman
,, 1962.3.2.246	Entebbe (Airport Beach)	,,
,, 1962.3.2.240–2	Kagera Port	E.A.F.R.O.
,, 1962.3.2.243–5	Ramafuta Isl. (Buvuma Channel)	,,
,, 1962.3.2.260–3	Entebbe Harbour	,,
,, 1962.3.2.253–9	Bufuka Bay	,,
,, 1962.3.2.264–270	Beach near Nasu point	,,
,, 1962.3.2.248	Karenia (near Jinja)	,,
,, 1962.3.2.271–3	Jinja pier	,,
,, 1962.3.2.274–6	Buka Bay	,,
	Kenya	
Paris Museum 04 × 150 (Holotype)	Kavirondo Gulf	
B.M. (N.H.).—1962.3.2.247	Near Usoma Lighthouse, Kavirondo Gulf	,,
,, 1962.3.2.250–1	Kasingiri Gingo, Kavirondo Gulf	,,
	Tanganyika	
B.M. (N.H.).—1962.3.2.249	Majita Beach	,,
	Lake Victoria, Locality Unknown	
B.M. (N.H.).—1901.6.24.89		Sir H. Johnston
,, 1911.3.3.23		Bayon
,, 1962.3.2.252		E.A.F.R.O.

Haplochromis bayoni (Blgr.) 1909

Text-fig. 3

Paratilapia bayoni (part) Blgr., 1909, *Ann. Mus. Genova* (3), **4**, 304, fig. (the figured specimen only; this specimen is now chosen as the lectotype); *Idem*, 1915, *Cat. Afr. Fish.*, **3**, 337, fig. 227 (figured specimen only).

The syntype on which Regan (1922) based his redescription of the species is no longer considered to be *H. bayoni*.

Lectotype. A male, 147 mm. S.L. (collected in the Sesse Islands by Bayon) i.e. the specimen figured by Boulenger (1909), now in the collections of the Museo Civicio distoria Naturale, Genoa (No. C.E. 12976).

Description. Based on twenty-three fishes (including the lectotype) 82–154 mm. S.L.

Depth of body 27·0–35·3 (M = 32·2) per cent of standard length, length of head 35·0–38·0 (M = 36·3) per cent. Dorsal head profile sloping at an angle of *ca.* 30°–35°, its otherwise straight outline broken anteriorly by the prominence of the premaxillary pedicels.

Preorbital depth 17·7–21·6 (M = 19·6) per cent of head length, least interorbital width 20·8–25·9 (M = 23·2) per cent. Snout longer than broad (1·2–1·3 times), its length 35·3–39·5 (M = 37·5) per cent of head. Eye diameter 17·5–21·9 (M = 20·0) per cent, depth of cheek 23·1–28·1 (M = 25·0) per cent.

Caudal peduncle 14·5–17·2 (M = 16·2) per cent of standard length, 1·1–1·6 (modal range 1·3–1·4) times as long as deep.

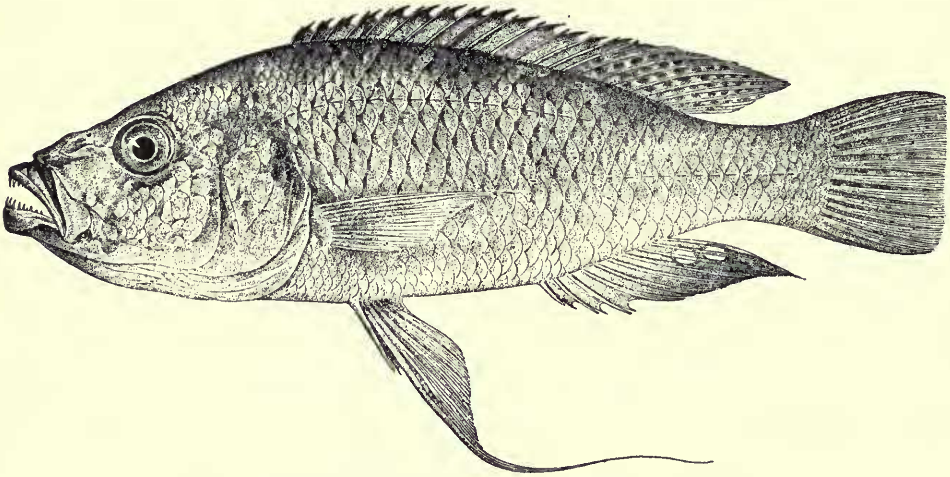

Fig. 3. *Haplochromis bayoni*; lectotype, ·73 × N.S. (From Boulenger, *Ann. Mus. Genova.*)

Mouth slightly oblique, the jaws equal anteriorly or the lower projecting slightly; lower jaw length 42·5–48·0 (M = 45·6) per cent of head, 1·7–2·5 (no definite mode) times as long as deep. Lips slightly thickened, the premaxilla noticeably expanded anteroposteriorly in the midline. Posterior tip of the maxilla not reaching the level of the anterior orbital margin, but generally reaching a point slightly behind the vertical through the posterior tip of the premaxillary pedicels.

Gill rakers usually slender or a mixture of slender and stout, 8–10 (mode 9) on the lower part of the first gill arch, the lowermost 1–3 rakers reduced.

Scales ctenoid; the lateral line with 29 (f.1), 30 (f.1), 31 (f.9), 32 (f.8), 33 (f.3) or 34 (f.1) scales. Cheek with 4 (less frequently 3) series of imbricating scales. Five or 6 (rarely 6½ or 7) scales between the lateral line and the dorsal fin origin, 5 or 6 (less frequently 7) between the pectoral and pelvic fin bases.

Fins. Dorsal with 23 (f.1), 24 (f.8), 25 (f.13) or 26 (f.1) rays, comprising 14 (f.4), 15 (f.18) or 16 (f.1) spinous and 9 (f.8), 10 (f.13) or 11 (f.2) branched rays. Anal with

12 (mode) or 13 rays, comprising 3 spinous and 9 or 10 branched elements. Caudal truncate. Length of pectoral fin 21·2–28·0 (M = 25·5) per cent of standard length. The pelvic fins have the first unbranched ray greatly produced and filamentous, its tip reaching to at least the third branched anal ray and usually to between the third and sixth rays. In some specimens it reaches to beyond the anal base. Both Boulenger (1911) and Regan (1922) imply that the ray is longer in males than in females but from my sample I can find no clear-cut sexual dimorphism. (Boulenger's remarks are probably attributable to his having another species in his study material). This lack of marked dimorphism is very unusual since in all other Victoria *Haplochromis* the adult male has noticeably longer outer pelvic rays. Indeed, the marked hypertrophy of the pelvic rays in both sexes constitutes one of the most reliable diagnostic characters for *H. bayoni.*

Teeth. In every specimen examined the *outer row* of teeth in both jaws is composed of unicuspid, slightly to moderately curved and relatively stout teeth. There are 34–52 (M = 44) outer teeth in the upper jaw, the number perhaps showing a positive correlation with standard length.

The *inner rows* are also composed of unicuspid teeth, and are implanted obliquely; there are 2 (less commonly 3) series in the upper jaw and 2 (less commonly 1) in the lower.

Osteology. The neurocranium is clearly derived from the *H. guiarti* type but is somewhat more advanced towards the " extreme " predator type of *H. mento* and *H. macrognathus* (see p. 209). Compared with *H. guiarti* the neurocranium has the ethmoid-vomer region more strongly decurved, the slope of the preorbital face less steep (*ca.* 35°), its height less (*ca.* 3 times in basal length *cf.* 2·5 times) and a lower supraoccipital crest. The relative length of the preotic portion of the skull is the same in both species (65% of basal length).

Vertebrae. 28–30, comprising 12–13 precaudal and 16 or 17 caudal elements (4 specimens examined).

Lower pharyngeal bone triangular, its dentigerous surface equilateral. The teeth are relatively coarse and are cuspidate ; the teeth of the two median rows slightly enlarged. There are 18–20 tooth rows.

Coloration. Data on the live colours of *H. bayoni* are not available. In preserved fishes *females and immature males* are greyish-brown above and silver below, sometimes with very faint traces of four short, transverse bars of irregular outline lying midlaterally ; less frequently these bars are joined by an even fainter longitudinal band. All fins are hyaline, the soft dorsal maculate and the proximal two-thirds of the caudal dark with traces of maculae. The only *adult males* available are sexually quiescent and have a coloration like that of the females except for a more intense midlateral stripe and more distinctly maculate dorsal. The pelvics are slightly dusky and there is a single row of three opaque ocelli on the anal fin.

Distribution. Known only from Lake Victoria. Earlier records (Boulenger, 1915) from Lake Kyoga were based on a misidentified specimen.

Ecology. Habitat. The species is apparently confined to water less than thirty feet deep and to hard substrates (sand or shingle). The majority of specimens come from exposed sandy beaches but some are from fairly exposed bays where the bottom was of sand or sand overlain by a thin slick of mud. Since only a few of Graham's specimens were preserved, it is impossible to use his records (Graham, 1929) for distributional purposes. If it be assumed that he identified his specimens correctly, then his locality records confirm my idea of the species' distribution.

Food. Information on the feeding habits of *H. bayoni* is scanty. Seven of the fifteen fishes examined (size range 82–154 mm. S.L.; from six different localities) had food in the stomach and/or intestines. In each case the food consisted entirely of finely macerated fish remains, identifiable in four specimens as being small cyprinid fishes (probably *Barbus* sp.). One fish (153 mm. S.L.) had the remains of two cyprinids (*ca.* 35 mm. S.L.) in the stomach and the remains of at least one other fish in the intestines.

Breeding. Nothing is known about the breeding habits of this species. Both sexes reach maturity at a size between 110 and 125 mm. S.L., and both reach the same maximum adult size.

Affinities. The extreme elongation of the first pelvic ray is unique amongst Lake Victoria *Haplochromis* and serves as a ready diagnostic character. On more fundamental structures, particularly the syncranial architecture, *H. bayoni* shows affinity with *H. guiarti* but the relationship is not especially close. In these same characters *H. bayoni* exhibits a further continuation of the trend leading towards the *H. mento*—*H. macrognathus* level of syncranial organization. Phyletically, *H. bayoni* could be considered as an isolated (but by no means aberrant) offshoot from an *H. guiarti*—like stem.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
Genoa Museum, No. C.E. 12976 (Lectotype)	Sesse Isls.	Bayon
B.M. (N.H.)—1962.3.2.160–3	Beach near Hannington Bay	E.A.F.R.O.
,, 1962.3.2.170–1	Beach near Nasu point	,,
,, 1962.3.2.172–4	Entebbe, Airport beach	,,
,, 1962.3.2.175–6	Entebbe, Harbour	,,
,, 1962.3.2.177	Kagera port	,,
	Tanganyika	
,, 1962.3.2.164–8	Majita Beach	,,
	Kenya	
,, 1962.3.2.169	Kavirondo Gulf	,,
	Lake Victoria, Locality Unknown	
,, 1962.3.2.178		,,

Haplochromis serranus (Pfeffer) 1896

Text-figs. 4, 5 and 25

Hemichromis serranus Pfeffer, 1896. *Thierw. D. ost. Afr., Fische*, 23.

Paratilapia prognatha (part): Blgr., 1915, *Cat. Afr. Fish.*, **3**, 333 (specimen B.M. (N.H.), Reg. No. 1906, 5.30.263).

Haplochromis acutirostris Regan, 1922, *Proc. zool. Soc. Lond.*, 180 (the lectotype [and figured specimen] Reg. No. as above).

I do not consider that any of the specimens used by Boulenger (1915) or Regan (1922) to redescribe the species can be referred to *H. serranus*. My concept of *H. serranus* is based on Pfeffer's original description and on supplementary notes and a figure made from the presumed type specimen by Dr. E. Trewavas. The additional material now available agrees more closely with my idea of the type than do Boulenger's and Regan's fishes.

Description. Based on fifty-two specimens, 101–205 mm. S.L. (including the type of *H. acutirostris*).

Depth of body 32·7–39·2 (M = 36·0) per cent of standard length, length of head 34·8–38·7 (M = 36·3) per cent. Dorsal head profile straight or slightly curved, sloping at an angle of 30°–40°, the premaxillary pedicels very prominent.

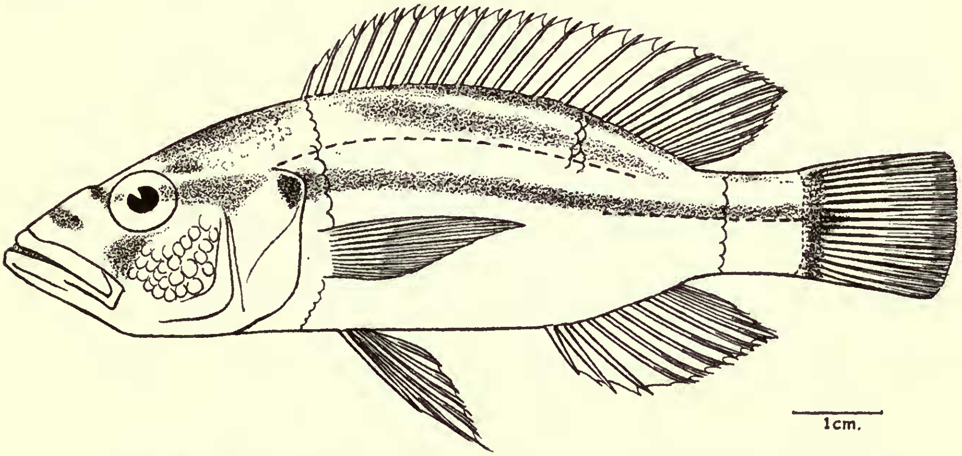

FIG. 4. *Haplochromis serranus*. (Outline drawing of a specimen in the Berlin Museum believed to be the holotype; made by Dr. E. Trewavas.)

Preorbital depth 14·6–20·0 (M = 17·7) per cent of head, ratio Eye/Preorbital 1·1–1·5, (M = 1·3.) Least interorbital width 20·4–26·8 (M = 23·3) per cent. Snout as long as broad in most specimens, but in some fishes <130 mm. S.L. it is slightly longer than broad; snout length 30·8–37·0 (M = 34·0) per cent of head, diameter of eye 20·4–26·0 (M = 23·3) per cent, depth of cheek 22·9–31·5 (M = 27·5).

Caudal peduncle length 13·3–19·6 (M = 15·4) per cent of standard length, 1·1–1·5 (mode 1·2) times as long as deep.

Lower jaw moderately oblique, sloping at an angle of 25°–30°, projecting slightly and with a distinct mental bump; its length 47·7–60·0 (M = 54·3) per cent of head and 1·8–2·5 (mode 2·0) times the breadth. Posterior tip of the maxilla extending to below the eye or to the vertical through the anterior orbital margin in most fishes, but not quite reaching this point in a few.

Gill rakers. Short and stout, 8 or 9 (rarely 7 or 10) on the lower part of the first gill arch, the lowermost one or two rakers reduced.

Scales ctenoid; lateral line with 30 (f.2), 31 (f.25), 32 (f.18), 33 (f.5) or 34 (f.1) scales, cheek with 4 (less frequently 5, rarely 3 or 6) rows; 6 or 7 scales between the lateral line and the dorsal fin origin, 7 or 8 (less frequently 9, rarely 6) between the pectoral and pelvic fin bases.

Fins. Dorsal with 24 (f.30), 25 (f.20) or 26 (f.2) rays, comprising 14 (f.2), 15 (f.40) or 16 (f.10) spinous and 8 (f.1), 9 (f.36) or 10 (f.15) branched rays. Anal with 11 (f.6), 12 (f.45) or 13 (f.1) rays, comprising 3 spines and 8–10 branched rays. Pectoral fin length 23·8–33·0 (M = 27·0) per cent of standard length. Caudal truncate (the lower posterior angle somewhat obliquely truncate in a few specimens) scaled on its basal half to two-thirds (rarely). Pelvic fin with the first ray slightly produced and filamentous, proportionately more so in adult males.

Teeth. In all specimens the majority of *outer teeth* are unicuspid but in some fishes <140 mm. S.L. a few bicuspids occur posterolaterally in the upper jaw. The teeth are moderately to strongly curved, the lateral teeth often more so than the anterior ones. There are 44–70 (M = 63) teeth in the upper outer row, the number showing some positive correlation with length in fishes <140 mm. S.L.

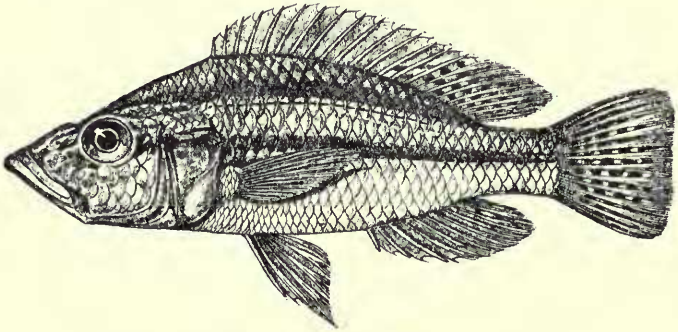

FIG. 5. *Haplochromis serranus* ; ·72 × N.S.
(From Regan, *Proc. zool. Soc. Lond.*; the type of *H. acutirostris* Regan.)

All the rows of *inner teeth* (except in some fishes <140 mm. S.L.) are composed of unicuspids.

In the smaller fishes the innermost row (especially in the upper jaw) may be composed of tricuspids or the entire inner series of both jaws may be of tricuspids. The inner teeth are arranged in 2 or 3, rarely 4, rows in the upper jaw and 2, less frequently 1 or 3 rows in the lower jaw.

Osteology. The neurocranium closely resembles that of *H. victorianus* (see p. 157) although the dorsal profile is slightly more curved. It can be considered as a development of the *H. guiarti* type.

Vertebrae. Twenty-eight or 29 (mode 29), comprising 12 (f.1) or 13 (f.6) precaudal and 15 (f.1) or 16 (f.6) caudal elements.

Lower pharyngeal bone triangular, its dentigerous surface very slightly broader than it is long. The teeth are moderately stout and cuspidate, and are arranged in 22–24 rows.

Coloration. The colours of live fishes are unknown.

Preserved material. Adult males. Ground colour light brown, greyish on chest and belly ; branchiostegal membrane black or dark grey. In some specimens there is a broad, dark, but faint midlateral band running from behind the operculum to the base of the caudal fin or onto the fin itself, and sometimes an even fainter, interrupted band running slightly below the base of the dorsal fin. The dark lachrymal stripe is very prominent and runs obliquely backwards and downwards from the lower anterior margin of the orbit to the angle of the lower jaw. Dorsal fin brown but with dark streaks between the rays and, in some specimens, with black lappets. Caudal fin darkly maculate. Anal grey-brown, darkest at the base of the spinous part; ocelli 2–4 in number, greyish and often ill-defined. If there are more than three ocelli, they are arranged in two rows of one and three. Pelvic fins black.

Adult females silvery brown, darker dorsally and apparently without longitudinal bands. All fins are brownish. *Juveniles of both sexes:* ground colour silvery-brown with a broad (sometimes faint) dark midlateral band from the operculum to the basal part of the caudal fin; lachrymal stripe, if visible, very faint. All fins are greyish, often with traces of maculae on the soft part of the dorsal.

Ecology. Habitat. Most records of *H. serranus* are from sheltered bays and gulfs where the bottom is of soft, organic mud and the depth of water less than 25 feet. A few specimens came from exposed habitats and were caught over sand or shingle, but again the water did not exceed 25 feet in depth. It should be noted that all the latter localities are near muddy areas. No locality is more than half a mile from the shore.

Food. The food of fishes in the size range 100–205 mm. S.L. is exclusively fish and predominantly *Haplochromis*; no other genus could be identified in the very macerated gut contents of the thirty specimens examined. Some food was, however, too finely divided to even hazard an identification.

Breeding. No information is available on the breeding habits of *H. serranus.* Most individuals <140 mm. S.L. are immature, but one female of 118 mm. S.L. shows early stages of oogenesis. Males and females reach the same adult size.

Distribution. Lake Victoria.

Affinities. Haplochromis serranus is closely related to *H. victorianus* and *H. nyanzae*, the three species apparently forming a species group amongst the larger predatory *Haplochromis* of Lake Victoria. In turn, this group is related to *H. spekii* and the relationship will be discussed in another paper. The differences distinguishing *H. serranus* from *H. nyanzae* are outlined on p. 161; from *H. victorianus*, it differs in its more oblique and longer lower jaw (47·4–60·0, M = 54·3 per cent of head *cf.* 44·0–51·8, M = 47·1 per cent), shorter pectoral fin (23·8–33·0, M = 27·0 per cent of standard length *cf.* 26·2–32·7, M = 30·4 per cent) and in having fewer teeth in the outer row of the upper jaw (44–70, M = 63, *cf.* 67–86 M = 74).

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.263 (Type of *H. acutirostris*)	Bunjako	Degen
,, 1962.3.2.27–36	Pilkington Bay	E.A.F.R.O.
,, 1962.3.2.37–51	Ekunu Bay	,,

Museum and Reg. No.	Locality	Collector
	Uganda (continued)	
B.M. (N.H.)—1962.3.2.52–3	Bukafu Bay	E.A.F.R.O.
,, 1962.3.2.54–5	Jinja pier	,,
,, 1962.3.2.56–7	Karenia (near Jinja)	,,
,, 1962.3.2.61–3	Pilkington Bay	,,
,, 1962.3.2.74–5	Williams Bay	,,
,, 1962.3.2.58	Ramafuta Isl.	,,
	Kenya	
,, 1962.3.2.26	Rusinga Isl.	,,
,, 1962.3.2.60	Naia Bay	,,
	Tanganyika	
,, 1962.3.2.59	Ihogororo	,,

Haplochromis victorianus (Pellegrin) 1904

Plate I

Paratilapia victoriana Pellegrin, 1904, *Bull. Soc. zool. France*, **29**, 185 ; *Idem*, 1905, *Mem. Soc. zool. France*, **17**, 182, pl. 17, fig. 3.

Pelmatochromis spekii (part) Blgr., 1906, *Ann. Mag. nat. Hist.* (7), **17**, 440 ; *Idem*, 1915, *Cat. Afr. Fish.*, **3**, 416 (one of the types, B.M. (N.H.) Reg. No. 1906.5.30.300).

Regan (1922) tentatively included *Paratilapia victoriana* in the synonymy of *Haplochromis nubilus*. I have examined the types of both species and can find nothing to substantiate this arrangement ; indeed, the two species are only distantly related. None of the specimens identified by Boulenger (1915) as *P. victoriana* can be referred to Pellegrin's species.

Holotype. A fish 120 mm. S.L. (Paris Museum Reg. No. 04 × 148) from Kavirondo Bay, Kenya.

Description. Based on twenty specimens 117–166 mm. S.L., including the holotype.

Depth of body 33·4–41·3 (M = 37·3) per cent of standard length, length of head 33·5–36·0 (M = 34·8) per cent. Dorsal profile of head usually straight (but sometimes with a slight concavity due to more prominent premaxillary pedicels), sloping at *ca.* 35°–45°.

Preorbital depth 17·9–20·5 (M = 19·2) per cent of head, ratio Eye/Preorbital 1·1–1·3 (mean 1·2), least interorbital width 21·5–24·5 (M = 22·6) per cent. Snout length 31·8–36·0. (M = 34·1) per cent of head, equal to its width ; diameter of eye 21·7–25·5 (M = 23·6), depth of cheek 22·5–26·2 (M = 24·6) per cent.

Caudal peduncle 13·5–19·6 (M = 17·1) per cent of standard length, 1·1–1·8 (mode 1·5) times as long as deep.

Lower jaw horizontal or slightly oblique, anteriorly equal to the upper or projecting slightly, its length 44·0–51·8 (M = 47·1) per cent of head, 1·6–2·2 (modal range 1·8–2·0) as long as broad ; there is always a well-developed mental prominence at the symphysis. The posterior tip of the maxilla reaches the vertical through the anterior orbital margin, or somewhat more posteriorly, in most specimens but does not reach the orbit in a few fishes.

Gill rakers short and moderately stout, 8 or 9 on the lower part of the first gill arch, the lowermost 1–3 rakers reduced.

Scales ctenoid, lateral line with 31 (f.3), 32 (f.6), 33 (f.9) or 34 (f.2) scales, cheek with 3 or 4 series. Six to 8 scales between the lateral line and the dorsal fin origin, 7 or 8 (rarely 6) between the pectoral and pelvic fin bases.

Fins. Dorsal with 24 (f.1), 25 (f.16), or 26 (f.3) rays, comprising 15 (f.4), 16 (f.14) or 17 (f.2) spinous and 9 (f.16) or 10 (f.4) branched rays. Anal with 11 (f.1), 12 (f.16) or 13 (f.3) rays comprising 3 spines and 8 (f.1), 9 (f.16) or 10 (f.3) branched rays. Caudal fin truncate, scaled on its basal half (rarely two-thirds). Pectoral 26·2–32·7 (M = 30·4) per cent of standard length. First pelvic ray slightly produced and filamentous in both sexes (an unusual feature).

Teeth. In fishes less than 125 mm. S.L., the *outer teeth* in both jaws are mostly bicuspids, but some may be weakly so ; fishes between 125 mm. and 130 mm. S.L. show an admixture of unicuspids and weakly bicuspids, or the unicuspids may predominate ; all fishes >135 mm. S.L. have only unicuspid teeth in this series. In all specimens the teeth are relatively slender and slightly curved. There are 64–86 (M = 74) in the outer row of the upper jaw.

The inner teeth are arranged in two or three rows in each jaw ; most specimens <130 mm. S.L. have either a mixture of uni- and tricuspids in apparently equal proportions, or one form may predominate. Fishes >135 mm. S.L. have only unicuspids in the inner series.

Osteology. The neurocranium is very similar to that of *H. serranus*. It is clearly distinct from that of *H. bayoni* (which seems to lead to the *H. mento* type) and is somewhat more substantial than the neurocranium of *H. guiarti* (which is nearest the generalized insectivore type of, say, *H. brownae*).

Vertebrae. Thirty (in the six specimens examined) comprising 13 precaudal and 17 caudal elements.

Lower pharyngeal bone triangular, the dentigerous surface noticeably broader than long. The teeth are cuspidate and slender, and are arranged in 22–24 rows ; the teeth of the two median rows are often enlarged relative to the others.

Coloration. Live fishes. In adult males the ground colour is a silvery-turquoise dorsally, shading to silver on the flanks and belly. Dorsal fin dark neutral, with black lappets and deep red maculae between the branched rays. Caudal fin dark neutral but with blood-red posterior and ventral margins. Anal dark neutral basally, black between the rays, and blood-red proximally ; the ocelli are orange-yellow and numerous. The pelvic fins are black. *Females*, have a similar ground coloration but lack the red areas on the caudal and anal fins, and the black area over the anal spines ; the pelvics are neutral and there are no anal ocelli.

Preserved material. Adult males. Ground colour brownish-grey above, becoming silver-grey on the flanks and belly. The branchiostegal membrane is sooty and there is a faint blackening on the chest and belly. Dorsal fin hyaline but with black lappets and dark maculae on the soft part. Caudal fin colourless but with numerous dark spots and streaks between the rays. Anal fin black between the spines, otherwise sooty-grey, the basal half being darker ; the greyish-white ocelli vary in number from three to seven and are arranged in one or two rows, those of the lower row being much smaller. Pelvic fins mottled black (appearing uniformly black when closed).

Females are brownish silver above and silver to silvery-yellow on the flanks and belly. All fins are colourless, the soft dorsal and the caudal sometimes weakly maculate. In some specimens there is a faint but broad and interrupted midlateral stripe from the posterior margin of the operculum to the base of the caudal fin.

Distribution. Lake Victoria.

Ecology. Habitat. The species has been recorded from only six different localities ; in five the bottom is of thick organic mud and in the sixth, shingle (but this place is near an area of mud) ; all localities are sheltered and the depth of water is between 20 and 40 feet.

Breeding. Very little information is available on the breeding habits of *H. victorianus*. With two exceptions (specimens 128 and 131 mm. S.L.) all the fishes examined were adult and included several individuals smaller than the exceptional juveniles. The largest fishes (166 mm. S.L.) are a male and a female.

Food. Fourteen of the twenty-seven fishes examined had ingested material in the gut. Of these, twelve had fed on fishes and two on organic mud. The fish remains are very finely divided and come from small fishes *ca.* 10–15 mm. S.L. (and this irrespective of the size of the predator). In two cases the fishes are identifiable as post-larval *Haplochromis*. The preponderance of small fishes in the prey is interesting because even in such a small sample most other predatory *Haplochromis* would have yielded remains of much larger prey fishes. There is, of course, usually some correlation between prey size and predator size, but in a sample covering a comparable size-range the prey fishes would be from 30–60 mm. S.L. Perhaps *H. victorianus* has specialized in feeding on post-larval fishes ?

The occurrence of mud in two specimens is inexplicable, particularly since there are no indications that the fishes had been feeding on insect larvae, a common alternative food in many otherwise piscivorous species.

Affinities. Haplochromis victorianus is very closely allied to *H. serranus* and *H. nyanzae*, see p. 161. The three species form a fairly well-defined group of deep-bodied and anatomically rather generalized species amongst the piscivorous predators of Lake Victoria.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.300 (Paratype *P. speki*)	Entebbe	Degen
,, 1962.3.2.478	Ramafuta Isl. (Buvuma channel)	E.A.F.R.O.
,, 1962.3.2.479–82	Karenia, near Jinja	,,
,, 1962.3.2.483–87	Pilkington Bay	,,
,, 1962.3.2.488–494	Ekunu Bay	,,
	Kenya	
Paris Museum 04 × 148 (Holotype)	Kavirondo Bay	,,
B.M. (N.H.).—1962.3.2.477	Naia Bay	,,

Haplochromis nyanzae sp. nov.

Text-fig. 6

Pelmatochromis spekii (part) : Blgr., 1915, *Cat. Afr. Fish.*, (one specimen B.M. (N.H.) Reg. No. 1909.5.4.17).
H. serranus (part) : Regan, 1922 ; *Proc. zool. Soc. Lond.* 174 (specimen as above).

Holotype. A specimen 154·0 mm. S.L. (B.M. (N.H.) Reg. No. 1962.3.2.495) from Jinja.

Description. Based on thirteen specimens (including the holotype) 126–171 mm. S.L.

Depth of body 33·8–38·6 (M = 36·3) per cent of standard length, length of head 33·6–36·7 (M = 35·4) per cent. Dorsal head profile straight or moderately concave, sloping at an angle of 30°–40°.

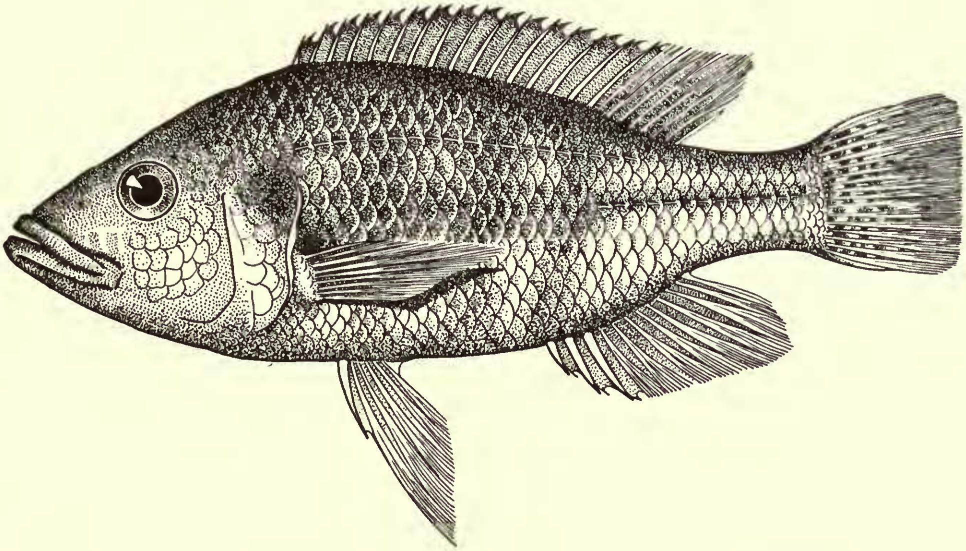

FIG. 6. *Haplochromis nyanzae* ; ·75 × N.S. (Drawn by Lavinia Beard.)

Preorbital depth 17·0–20·2 (M = 18·9) per cent of head, least interorbital width 20·0–24·5 (M = 22·2) per cent. Snout length 33·4–35·8 (M = 34·5) per cent of head, 1·0–1·1 times as long as broad. Eye diameter 19·1–24·0 (M = 22·1) per cent, ratio Eye/Preorbital 1·1–1·3 (M = 1·2), depth of cheek 24·4–27·6 (M = 25·9) per cent.

Caudal peduncle length 14·0–17·6 (M = 15·9) per cent of standard length, 1·1–1·4 (mode 1·4) times as long as deep.

Lower jaw moderately oblique, sloping at an angle of 25°–30°, anteriorly equal to the upper jaw or projecting slightly, its length 45·0–51·6 (M = 48·0) per cent of head, 1·5–2·0 (Mode 1·7) times as long as broad. The anterior outline of the dentary is smoothly curved and lacks a strong mental projection. The posterior tip of the maxilla usually reaches the vertical through the anterior orbital margin, but in some fishes it extends beyond this point or does not reach it.

Gill rakers short and stout (rarely short and slender), 8 or 9 (rarely 7 or 10) on the lower part of the first gill arch, the lowermost one or two rakers reduced.

Scales ctenoid ; lateral line with 31 (f.1), 32 (f.8) or 33 (f.4) scales, cheek with 4 or 5 (rarely 3) rows. Seven or 8 (rarely 6 or 9) scales between the dorsal fin origin and the lateral line, and between the pectoral and pelvic fin bases.

Fins. Dorsal with 24 (f.5) or 25 (f.8) rays, comprising 15 (f.2) or 16 (f.11) spinous and 8 (f.4), 9 (f.8) or 10 (f.1) branched rays. Anal with 12 rays (3 spinous, 9 branched) in all except one specimen which has only 2 spines and 9 rays. Pectoral fin 22·8–28·2 (M = 24·9) per cent of standard length. First pelvic ray very slightly produced in males and less so in females. Caudal truncate, scaled on its basal two-thirds.

Teeth. The *outer* row in both jaws is composed of unicuspid, moderately stout teeth, strongly incurved in most specimens, but less strongly in a few others. The number of teeth in this row shows a very slight positive correlation with standard length ; for the whole sample there are 50–76 (M = 60) upper teeth.

The *inner teeth* are uni- and tricuspid in fishes <135 mm. S.L. and unicuspid in larger fishes. There are 2–4 (usually 3) rows in the upper jaw and 2 or 3 in the lower.

Osteology. With so few specimens available, I have not been able to prepare any skeletal material. However, on comparing radiographs of this species with others of *H. victorianus* I can find no great differences in neurocranial form or general syncranial arrangement. If anything, the supraoccipital crest in *H. nyanzae* is relatively lower and the slope of the dorsal skull profile is a little less steep.

Vertebrae. 29 (f.2), 30 (f.4) or 31 (f.1), comprising 13 (f.5) or 14 (f.2) abdominal and 16 (f.3) or 17 (f.4) caudal elements.

Lower pharyngeal bone triangular, its dentigerous surface noticeably broader than long. The teeth are slender, cuspidate and arranged in 22–24 rows. Except in the most posterior transverse row or two the teeth of the median rows are not enlarged.

Coloration. Unknown in live fishes. *Preserved material. Adult males* have a dark brown ground colour with an overlying greyish tinge ; the belly, ventro-lateral aspects of the flanks, the ventral part of the preoperculum and the branchiostegal membrane are sooty. There is a distinct but narrow black lachrymal stripe, a faint black midlateral band and a fainter dorsolateral band following the upper lateral line. The lateral bands are crossed by five or six faint transverse bars. The dorsal fin is dark brown with darker spots and streaks between the soft rays. Caudal fin dark brown, anal brown with a faint and narrow darker flush along its base. Pelvic fins mottled black. In other males (whose sexual state could not be determined) the general ground coloration is much darker, the lower jaw, snout and ventral aspects of the cheek, preoperculum and operculum are black, the dorsal fin is darker (almost black) and the spots on the soft part are more obvious. The caudal fin too is darker, but the anal is similar. The anal ocelli in all males are difficult to distinguish.

Females are brown above, shading to silver-bronze on the flanks and belly. All fins are yellowish-brown, the dorsal with a grey overtone which is concentrated basally and outlined in black on the soft dorsal so that there appears to be a ventro-caudally curved dark stripe passing across it from the tip of the last spine to the middle of the last branched ray. Usually there is a dark midlateral band on the body, ending as a distinct blotch on the caudal fin base ; traces of three or four transverse bands may be visible on the flanks.

Immature and quiescent males are indistinguishable from females, although quiescent males often show a distinct darkening of the pelvic fins and faint indications of ocelli on the anal fin.

Ecology. Habitat. The available specimens of *H. nyanzae* are from five localities, of which four lie within the Napoleon Gulf and the fifth (a small island) in the nearby Buvuma Channel. In all localities the bottom is hard (shingle or rock) and the water less than twenty feet deep. The Napoleon Gulf stations are relatively sheltered but the island is exposed.

Food. Eight of the thirteen fishes examined contained food in the stomach or intestines. All eight had fed on fishes (identifiable in each case as *Haplochromis*) but one had a few insect remains in the intestine. Judging from the size of the scales and vertebrae in the gut contents, the prey fishes must have been between 30 and 60 mm. S.L.

Breeding. No data are available. All the specimens are adult.

Affinities. Haplochromis nyanzae is closely related to both *H. victorianus* and *H. serranus*. It differs from both species in the nature of the coloration in preserved males. From *H. victorianus* it is distinguished by its more oblique lower jaw (which also lacks a pronounced mental bump), shorter pectoral fin (22·8–28·2, M = 24·9% of S.L., *cf.* 26·2–32·7, M = 30·4%) and fewer teeth in the upper jaw (50–76, M = 60 ; *cf.* 64–86, M = 74). From *H. serranus* it is most readily differentiated by its rounded dentary (i.e. no pronounced mental bump), shorter lower jaw (45·0–51·6 M = 48·0, *cf.* 47·4–60·0, M = 54·3% of head) and shorter pectoral fin (22·8–28·2, M = 24·9, *cf.* 23·8–33·0 M = 27·0% of standard length).

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1962.3.2.495 (Holotype)	Jinja bay	E.A.F.R.O.
,, 1962.3.2.500	Jinja pier	,,
,, 1962.3.2.501–3	Karenia (near Jinja)	,,
,, 1962.3.2.504–7	Jinja (below golf course)	,,
,, 1962.3.2.496–8	Ramafuta Isl. (Buvuma channel)	,,
,, 1909.5.4.17	Sesse Isls.	Bayon

Haplochromis bartoni sp. nov.

Text-fig. 7

Note. The trivial name is given because the species resembles *H. worthingtoni*, a species named in honour of Dr. E. Barton Worthington.

Holotype. A specimen 145·0 mm. S.L. (B.M. [N.H.] Reg. No. 1962.3.2.277) from Ekunu Bay.

Description based on thirty-five specimens (including the holotype) 135–195 mm. S.L.

Depth of body 31·4–37·9 (M = 34·0) per cent of standard length, length of head 36·2–39·7 (M = 37·5) per cent. Dorsal head profile straight or very slightly curved, sloping at about 40°; premaxillary pedicels moderately prominent, sometimes giving the profile a noticeable concavity.

Preorbital depth 17·0–22·4 (M = 20·0) per cent of head, least interorbital width 17·0–21·0 (M = 18·6) per cent. Snout 33·4–40·3 (M = 36·0) per cent of head, and 1·1–1·2 times as long as broad; diameter of eye 20·3–24·1 (M = 22·5), depth of cheek 23·4–30·2 (M = 27·0) per cent.

Caudal peduncle 13·3–17·2 (M = 15·0) per cent of standard length, 1·2–1·5 (mode 1·3) times as long as deep.

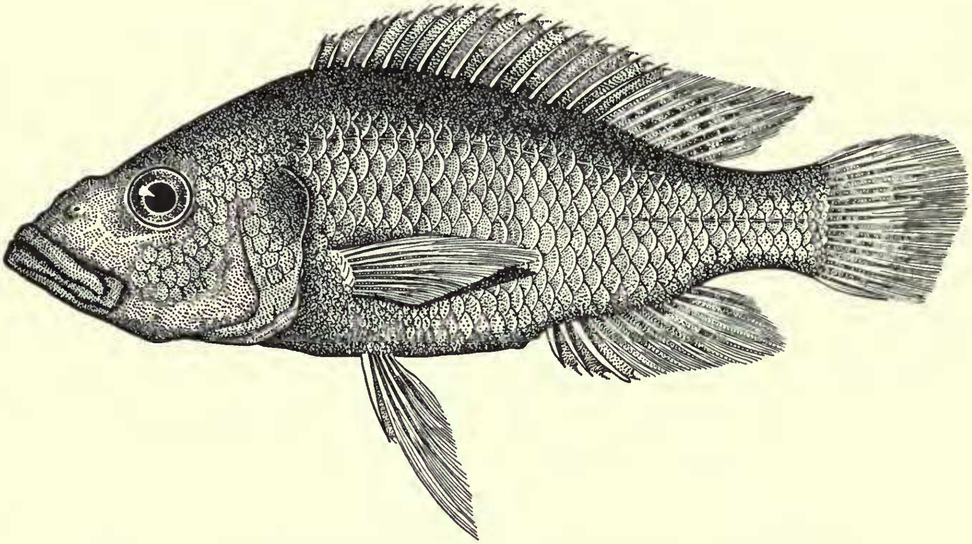

FIG. 7. *Haplochromis bartoni*; ·75 × N.S. (Drawn by Lavinia Beard.)

Mouth slightly oblique; the lower jaw sloping at *ca.* 10°–15° and projecting beyond the upper, usually with a slight mental protuberance. Length of lower jaw 50·8–57·0 (M = 52·5) per cent of head, 1·9–3·0 tines as long as broad. The medial dentigerous part of the premaxilla is not expanded anteroposteriorly. Lips slightly thickened. Posterior tip of the maxilla reaching the vertical through the anterior orbital margin in most fishes (56% of sample) and to a point slightly beyond or slightly anterior to the vertical in the remainder.

Gill rakers short and stout, 8 or 9 (rarely 7) on the lower part of the first arch, the lowermost 1–3 rakers reduced.

Scales ctenoid, lateral line with 31 (f.6), 32 (f.8), 33 (f.19) or 34 (f.2) scales, cheek with 4 (less frequently 3, rarely 5) rows. Six or 7 scales (rarely 7½) between the lateral line and the dorsal origin, 7 or 8 (rarely 6) between the pectoral and pelvic fin bases.

Fins. Dorsal with 23 (f.2), 24 (f.6), 25 (f.18) or 26 (f.8) rays, comprising 14 (f.3), 15 (f.10) or 16 (f.21) spines and 8 (f.2), 9 (f.19), 10 (f.11) or 11 (f.2) branched rays. Anal fin with 11 (f.4), 12 (f.30) or 13 (f.1) rays comprising 3 spines and 8–10 branched rays. Pectoral fin 23·3–27·0 (M = 25·0) per cent of standard length. First pelvic ray slightly elongate in adult males. Caudal with a slightly oblique distal margin in many specimens, but vertically truncate in others; the obliquely truncate type is less oblique than in *H. plagiostoma* (see p. 200). The caudal is scaled on its proximal two-thirds to four-fifths.

Teeth. The *outer row* in both jaws is composed of slender, curved and unicuspid teeth, of which there are 50–80 (M = 62) in the upper jaw. The *inner rows* in most fishes >150 mm. S.L. are composed of unicuspid teeth but in most smaller fishes there is an admixture of uni- and weakly tricuspids in both jaws, or either type of tooth may predominate. In the latter case it is usually the innermost series of the upper jaw which is predominantly tri- or weakly tricuspid, the lower jaw containing mostly unicuspids. There are 2 or 3 (less frequently 4) rows in the upper jaw and 1 or 2 (very rarely 3) in the lower jaw; all inner teeth are implanted obliquely, so that in many specimens the teeth lie horizontally.

Osteology. The *neurocranium* is roughly intermediate between the *H. bayoni*-type (see p. 151) and the *H. mento*-type (see p. 176). The medial toothed part of the premaxilla is not markedly expanded, but it does show some development in that direction. This bone is, however, nearer the generalized *H. guiarti*-type than is the premaxilla of *H. bayoni.*

Vertebrae. Twenty-nine or 30 (mode), comprising 13 abdominal and 16 (f.2) or 17 (f.4) caudal elements.

Lower pharyngeal bone triangular, its dentigerous surface broader than long or equilateral; only rarely is it slightly longer than broad. The teeth are slender (but become coarser in larger fishes), cuspidate and arranged in 20–22 somewhat irregular rows.

Coloration. Live colours are unknown.

Preserved females are brown above the upper lateral line and on the dorsal surface of the head. A dark midlateral stripe runs from behind the operculum to the base of the caudal fin and, in some specimens, can also be seen on the basal half of the caudal fin membrane. Less well-defined, and absent in some fishes, is a dark band from the snout, through the eye and onto the operculum where it becomes continuous with the midlateral band. All fins colourless, the soft dorsal weakly maculate. *Adult males* are uniformly greyish-brown, except for the branchiostegal membrane, chest and belly which are sooty. Dorsal fin grey, with black lappets and dark, often coalesced maculae on the soft part. Anal fin black in the region of the spines and dark along its proximal half; distal part colourless. Anal ocelli whitish-grey, five or six in number and arranged in two rows. Caudal fin brown with dark streaks between the rays; pelvic fins black.

Distribution. Lake Victoria.

Ecology. Habitat. The species has been recorded from several different habitats, whose common features are: a depth of water less than twenty feet and the nearness of dense plant stands. The habitats include a sheltered gulf with a hard substrate, sheltered bays with deep mud bottoms, sheltered beaches with hard and soft substrates, an exposed sandy beach and a rock shelf extending from a partially exposed island. *Haplochromis bartoni* seems to be more abundant in the sheltered habitats and, from its relative scarcity in seine-net catches, it seems to be most abundant some distance offshore (between 200–300 yards).

Food. Nineteen of the thirty-one specimens examined contained food in the stomach or intestines ; all had fed exclusively on fishes and the remains could be identified as follows : Cichlidae (undetermined) (f.5), *Haplochromis* spp. (f.11), Cyprinidae (undertermined) (f.1) ; unidentifiable fish remains (f.2).

Breeding. Little information is available on this species. Sexual maturity is reached at about the same size (145 mm. S.L.) in both sexes and there is no marked dimorphism in the maximum size attained.

Affinities. Some specimens of *H. bartoni* bear a superficial resemblance to the holotype and only specimen of *H. worthingtoni*, a Lake Kyoga species. However, the likeness is purely superficial and the two species differ in several morphological characters. Within the Victoria species-flock, *H. bartoni* is somewhat isolated, not by any outstanding morphological characters but by the sum of several small characters. The neurocranium is nearest that of the *H. mento* complex but it still retains some of the more generalized characters. The premaxilla is of the specialized " beaked " type found in *H. macrognathus*. Another superficial resemblance is to the *H. serranus-H. victorianus* complex, but here the likeness is confined to general facies and is not borne out by any deeper-lying details. *Haplochromis bartoni* could represent one of the stages in the evolution of a *H. mento*-type from a *H. guiarti*-like stem, but a stage nearer the " *mento* " than the " *guiarti* " level of organization. Equally. it could link the *H. serranus* group with the *H. mento* complex, but again it would be nearer the " *mento* " than the " *serranus* " condition.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1962.3.2.277 (Holotype)	Ekunu Bay	E.A.F.R.O.
,, 1962.3.2.278–82	Ekunu Bay	,,
,, 1962.3.2.283–6	Pilkington Bay	,,
,, 1962.3.2.287–92	Ramafuta Isl. (Buvuma ch.)	,,
,, 1962.3.2.293–8	Fielding Bay	,,
,, 1962.3.2.299–300	Karenia (near Jinja)	,,
,, 1962.3.2.301	Old Bukakata	,,
,, 1962.3.2.302	Beach near Nasu point	,,
,, 1962.3.2.303–6	Jinja pier	,,
,, 1962.3.2.307–13	Jinja (below golf course)	,,

Haplochromis estor Regan 1929

Text-figs. 8 and 25

Haplochromis estor Regan, 1929, *Ann. Mag. nat. Hist.*, (10), **3**, 391.

Holotype. A specimen 153 mm. S.L. from an unknown locality in Lake Victoria, collected by M. Graham. B.M. (N.H.) Reg. No. 1959.7.2.1.

Description. Based on the holotype and eight other specimens, 141–170 mm. S.L.

Depth of body 29·6–32·4 (M = 30·3) per cent of standard length, length of head 37·2–38·5 (M = 37·8) per cent. Dorsal head profile sloping fairly steeply (*ca.* 40°), the premaxillary pedicels prominent.

Preorbital depth 19·3–20·6 (M = 19·8) per cent of head, least interorbital width 20·4–23·7 (M = 21·6) per cent. Snout 1·2–1·3 times longer than broad, its length 34·5–37·0 (M = 36·2) per cent of head ; diameter of eye 20·4–23·5 (M = 21·7) per cent, depth of cheek 22·8–25·4 (M = 24·5) per cent.

Caudal peduncle 14·3–16·1 (M = 15·8) per cent of standard length, 1·3–1·6 times as long as deep.

Mouth slightly oblique (15°–20°), lower jaw always projecting, sometimes strongly so ; its length 54·2–57·5 (M = 55·5) per cent of head, 2·1–2·5 times as long as broad. Lips slightly thickened, the premaxilla with the medial dentigerous surface anteroposteriorly expanded. Posterior tip of the maxilla usually reaching the vertical through the anterior orbital margin, occasionally extending somewhat behind this line.

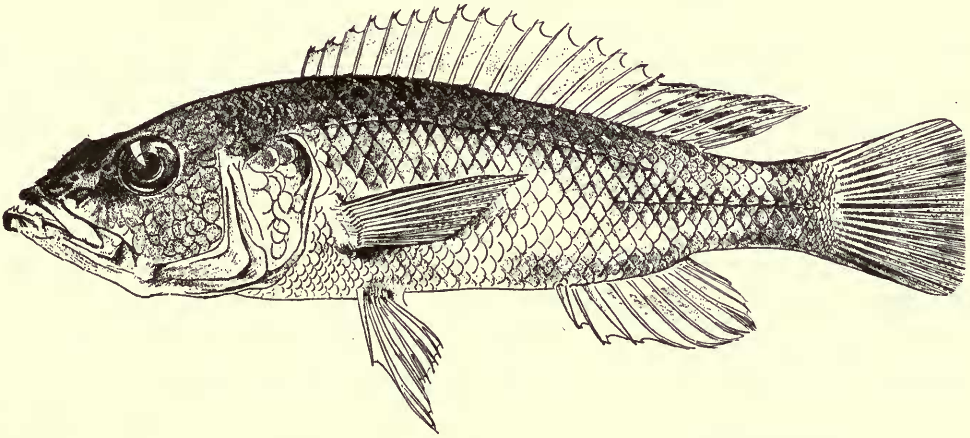

FIG. 8. *Haplochromis estor* ; holotype. (Drawn by Miss M. Fasken.)

Gill rakers short and stout, 8 or 9 on the lower part of the first gill arch, the lowermost one to four rakers reduced.

Scales ctenoid, lateral line with 32 (f.3), 33 (f.5) or 34 (f.1) scales, cheek with 4 (rarely 3) series of scales ; 6 or 7 (rarely $5\frac{1}{2}$ or 8) between the lateral line and the dorsal fin origin, 7 or 8 (rarely 6) between the pectoral and pelvic fin bases.

Fins. Dorsal with 24 (f.1), 25 (f.5) or 26 (f.3) rays, comprising 15 (f.1) or 16 (f.8) spines and 9 (f.6) or 10 (f.3) branched rays. Anal with 11 or 12 (mode) rays, comprising 3 spines and 8 or 9 branched rays. Pectoral fin 21·8–25·3 (M = 23·6) per cent of standard length. First pelvic ray produced in males. Caudal truncate or very slightly emarginate, scaled on its basal third or half.

Teeth. The *outer row* in both jaws is composed of moderately stout, strongly curved unicuspid teeth, of which there are 52–70 (M = 60) in the upper jaw. The *inner teeth* are tricuspid in the smallest specimen examined (141 mm. S.L.) but are unicuspid in all others. These teeth are implanted obliquely and arranged in 3 or 4 (less frequently 2) rows in the upper jaw and in 2 or an irregular single row in the lower jaw.

Osteology. The neurocranium of *H. estor* is of the *H. mento* type and, because of its more ventrally curved vomer, closely approaches that of *H. dentex* (see p. 168).

Vertebrae : 29–30 comprising 12 or 13 precaudal and 16 or 17 caudal elements in the eight specimens examined.

Lower pharyngeal bone triangular, the breadth of the dentigerous surface slightly greater than its length or, less frequently, equal to its length. The teeth are relatively slender and bicuspid, and are arranged in 18–22 rows.

Coloration unknown in life. *Preserved males* (sexually active). Ground colour dark chocolate-brown above becoming dusky over silver below, especially on the chest and belly ; faint traces of a dark midlateral stripe from the opercular margin to the caudal base are sometimes visible. Lachrymal stripe broad. Lips and lower jaw almost black, the branchiostegal membrane black. Dorsal fin dark grey, the soft part maculate. Caudal fin dark grey and densely maculate, the spots on the proximal half often coalesced so that the fin is dark proximally and lighter distally. Anal greyish with an ill-defined darker band along the distal margin, and a black but narrow band along the basal part ; 2–5 grey-white ocelli are present, arranged in two rows if there are more than four ocelli. Pelvics black. *Quiescent males* have a similar coloration but are much lighter ; consequently the midlateral stripe is more obvious. The dorsal fin lacks spots.

Females are brown, shading to silver on the belly and chest ; a faint midlateral stripe, and in one specimen three very faint and incomplete vertical cross bars are visible. Dorsal fin neutral, the soft part maculate. Caudal dark and maculate. Anal and pelvic fins yellowish.

Distribution. Lake Victoria.

Ecology. Habitat. Four of the localities from which *H. estor* has been obtained are sheltered bays and gulfs where the substrate is mud and the water between 10 and 20 feet deep. No information is available for the two other localities. It can certainly be said that the species (at least when adult) does not occur commonly, if at all, in exposed inshore areas of the lake.

Food. Five of the eight specimens examined had food in the stomach and intestines. Each had fed exclusively on fishes (identifiable as *Haplochromis* in four cases and merely as " fish " in the fifth).

Breeding. No information is available. All the specimens are adult ; the two smallest are females and the rest males.

Affinities. The affinities of *H. estor* are discussed in connection with *H. dentex* (p. 169) *Haplochromis estor* is more advanced towards the extreme *H. macrognathus* type, but is nevertheless more closely allied to *H. dentex* than to *H. macrognathus* or even *H. mento.* Regan (1929) compared *H. estor* with *H. pellegrini*. There is a superficial resemblance and probably an overall phyletic relationship between the species, but it is not, in my opinion, as close as the relationships suggested above.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1962.3.2.231	Karenia (near Jinja)	E.A.F.R.O.
,, 1962.3.2.232–4	Jinja pier	,,
,, 1962.3.2.235–6	Bugungu (opp. Jinja)	,,
,; 1962.3.2.237	Entebbe	,,
,, 1962.3.2.238	Ekunu Bay	,,
,, 1962.3.2.239	Pilkington Bay	,,
	Lake Victoria, Locality Unknown	
,, 1959.7.2.1 (Holotype)		M. Graham

Haplochromis dentex Regan 1922

Text-figs. 9 and 25

Paratilapia longirostris (part) : Blgr., 1915, *Cat. Afr. Fish.*, **3**, 332.
Haplochromis dentex Regan, 1922, *Proc. zool. Soc. Lond.*, 182, pl. 3, fig. 1.

Holotype. A specimen 127·0 mm. S.L. from the Sesse Islands, B.M. (N.H.) Reg. No. 1909.5.4.1.

Description based on fifteen specimens (91·0–159·0 mm. S.L.) including the holotype.

Depth of body 24·6–29·5 (M = 26·7) per cent of standard length, length of head 33·3–36·2 (M = 34·9) per cent. Dorsal head profile gently curved, the premaxillary pedicels prominent.

Preorbital depth 18·7–24·5 (M = 21·7) per cent of head, least interorbital width 20·0–24·5 (M = 22·5) per cent. Snout longer (1·3–1·5 times) than broad, its length 36·0–41·5 (M = 38·8) per cent of head ; diameter of eye 17·3–25·7 (M = 20·4) per cent, depth of cheek 22·1–27·5 (M = 24·6) per cent.

Caudal peduncle length 17·0–19·8 (M = 18·2) per cent of standard length, 1·6–2·0 times longer than deep.

Angle of mouth variable, from almost horizontal to slightly oblique (15°–20°). Lower jaw projecting slightly, its length 43·8–49·0 (M = 46·0) per cent of head and 2·0–2·5 times its breadth. Lips moderately thickened, the medial dentigerous surface of the premaxilla expanded anteroposteriorly. Posterior tip of the maxilla not reaching the vertical through the anterior orbital margin but always behind a vertical through the posterior tip of the premaxillary pedicels.

Gill rakers moderately slender ; 9 or 10 (mode) on the lower part of the first gill arch, the lowermost one to three rakers reduced.

Scales ctenoid ; lateral line with 33 (f.10) or 34 (f.5) scales (in one specimen there are no lateral line pores on one side). Cheek with 3 or 4 (mode) rows. Five to 7 scales between the lateral line and the dorsal fin origin, 7 or 8 between the pectoral and pelvic fin bases.

Fins. Dorsal with 24 (f.1), 25 (f.12) or 26 (f.2) rays, comprising 15 (f.8) or 16 (f.7) spines and 9 (f.6) or 10 (f.9) branched rays. Anal fin with 11–13 rays, comprising 3 spines and 8–10 (mode 9) branched rays. Pectoral fin 20·7–25·3 (M = 24·6) per cent of standard length. Caudal truncate or weakly emarginate, scaled on its basal two-thirds. First pelvic ray produced in males.

Teeth. The *outer row* in both jaws is composed of large, well-spaced, unicuspid, moderately slender and curved teeth. There are 32–48 (M = 36) in the outer row of the upper jaw.

In all except the two smallest fishes (91 and 100 mm. S.L.) the *inner teeth* are unicuspid. The two small fishes have a mixture of unicuspids, tricuspids and weakly tricuspids, in which the unicuspids predominate. The outermost row in both jaws is composed of teeth only a little smaller than those of the outer row. There are two rows of inner teeth (sometimes irregularly arranged and giving the impression of three rows) in the upper jaw and a single (rarely) double row in the lower jaw.

Osteology. The neurocranium of *H. dentex* clearly belongs to the *H. estor-mento-macrognathus* group. The preotic part is long (65·8% of basal length), the skull is narrow and shallow (neurocranial height 3·4 times in basal length) and the supraoccipital crest is low. It differs, however, from other members of the group in its sharply decurved ethmoid-vomer region which slopes at about 40° (the neurocranial roof slopes at *ca.* 25°). In general, the neurocranium of *H. dentex* is nearest that of *H. estor*, differing mainly in having a sharply decurved vomer.

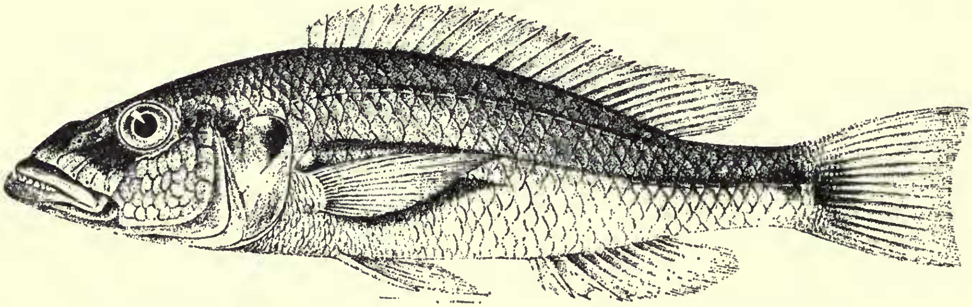

FIG. 9. *Haplochromis dentex*, holotype, ·8 × N.S. (From Regan, *Proc. zool. Soc. Lond.*)

Vertebrae. 30–32 (mode 31 in the ten specimens examined), comprising 13 (f.3) or 14 (f.7) precaudal and 16 (f.1), 17 (f.6) or 18 (f.3) caudal elements.

Lower pharyngeal bone triangular, its dentigerous surface as long as broad or slightly broader than long. The pharyngeal teeth are slender, fine and bicuspid except for the coarser and less obviously cuspidate teeth in the two median and last transverse rows. There are 18–20 rows of teeth.

Coloration. The colours of live fishes are unknown. *In preserved material* there is little difference in the coloration of males and females. The ground colour is dark grey above becoming silvery-grey below (darker in males). In some females there is a faint and narrow midlateral longitudinal stripe from the hind margin of the operculum to the caudal origin. Dorsal and caudal fins are greyish, the former with black lappets and the latter sometimes maculate. The anal and pelvic fins are hyaline in females, whereas in males the anal is greyish with a narrow black basal line running above the spines. In males there are two dead-white anal ocelli, and the pelvics are black.

Distribution. Lake Victoria.

Ecology. Habitat. Since only fifteen specimens are known, it is impossible to generalize on habitat preferences particularly since about half the specimens are from sheltered bays with mud substrates, and the others from exposed, sandy beaches, open off-shore waters with rock and shingle bottoms, and a fairly exposed gulf, also with a hard substate. The depth range extends to at least 25 feet, but the species cannot be considered common in any of the habitats investigated.

Food. Only three of the fifteen specimens available had ingested material in the gut. Two specimens had fed on small *Haplochromis* ; in the intestine of the third was a small quantity of fragmentary plant tissue.

Breeding. The breeding habits of *H. dentex* are unknown. The two smallest fishes (91 and 100 mm. S.L.) are both immature and the next largest (128 mm.) may also be a juvenile. All the other specimens (142–159 mm.) are adult.

Affinities. Superficially, *H. dentex* looks intermediate between the *H. guiarti*-type and the more specialized *H. mento-estor* types. But, closer study shows that it has greater affinity with the latter group, particularly with regard to its neurocranial form and the expanded medial dentigerous part of the premaxilla. *Haplochromis dentex* is perhaps most closely related to *H. estor*, although the latter has progressed further along the *H. mento-H. macrognathus* path of specialization. The supposed relationship between *H. dentex* and *H. estor* is based both on points of overall similarity and on likeness in the neurocrania of the two species. *Haplochromis dentex* is, however, easily distinguished by its fewer and larger teeth (mean number of teeth in the outer row of the upper jaw 37 *cf.* 60) and its shorter lower jaw (43·8–49·0, M = 46·0 per cent of head *cf.* 48·0–57·5, M = 54·9 per cent). The ancestry of *H. dentex* is obscure ; possibly it was derived from a *H. pellegrini*-like stem.

Study material and distribution records

Museum and Reg. No.		Locality	Collector
		Uganda	
B.M. (N.H.).—1909.5.4.1 (Holotype)		Sesse Isls.	Bayon
,,	1962.3.2.129	Sesse Isls.	E.A.F.R.O.
,,	1962.3.2.130–1	Macdonald Bay	,,
,,	1962.3.2.132	Grant Bay	,,
,,	1962.3.2.133–4	Jinja	,,
,,	1962.3.2.135–6	Buka Bay	,,
,,	1962.3.2.137	Kagera port	,,
,,	1962.3.2.138	Ramafuta Isl. (Buvuma channel)	,,
,,	1962.3.2.139	Ekunu Bay	,,
,,	1962.3.2.140	Thruston Bay	,,
,,	1962.3.2.142	Old Bukakata Bay	,,
		Kenya	
,,	1962.3.2.141	Kamiriga, Kavirondo Gulf	,,

Haplochromis artaxerxes sp. nov.

This peculiar species is represented by a single specimen. Its diagnostic characters are such, however, that I have little hesitation in basing the description on one fish. The specific name is derived from Artaxerxes, King of Persia, also known as *Longimanus* and alludes to the extremely long pectoral fins of this species.

Holotype a male 147·0 mm. standard length, from the Napoleon Gulf near Jinja; B.M. (N.H) Reg. No. 1962.3.2.508.

Description. Depth of body 27·9 per cent of standard length, length of head 32·7 per cent. Dorsal head profile gently curved, the premaxillary pedicels not making a prominent projection.

Preorbital depth 17·7 per cent of head, least interorbital width 20·8 per cent. Snout 1·25 times as long as broad, its length 33·3 per cent of head; eye diameter 22·9 per cent, depth of cheek 22·9 per cent.

Caudal peduncle 19·0 per cent of standard length , 1·7 times as long as deep.

Lower jaw rather flat and closing within the upper, the anterior tip projecting. Length of lower jaw 48·0 per cent of head, 2·3 times as long as broad. Median dentigerous area of the premaxilla not expanded anteroposteriorly. Posterior tip of the maxilla reaching the vertical through the anterior orbital margin. Mouth very slightly oblique, sloping at about 10°.

Gill rakers short and stout, 9 on the lower part of the first gill arch, the three lowermost rakers reduced.

Scales ctenoid; lateral line with 34 scales, cheek with 4 series. Seven scales between the lateral line and the dorsal origin, 9 between the pectoral and pelvic fin bases.

Fins. The pectoral fins of this species provide the most readily diagnostic character since they are longer (34·7% of standard length) than in any other Lake Victoria species. Only the third and fourth pectoral rays are produced so that the shape of the fin is also characteristic.

Dorsal with 15 spinous and 10 branched rays, anal with 3 spines and 9 branched rays. The distal margin of the caudal is damaged so its outline cannot be determined. The first branched pelvic ray is elongate and filamentous, in fact, intermediate between the extreme condition found in *H. bayoni* (see p. 151) and that of other species.

Teeth. Most of the outer teeth in both jaws are missing. The few remaining teeth are unicuspid, slender and very strongly curved. The inner teeth are unicuspid and arranged in two series in the upper jaw and a single, irregular row in the lower jaw.

Osteology. Neurocranial shape cannot be determined from a radiograph. There are 31 vertebrae (13 precaudal and 18 caudal). The lower pharyngeal bone is slender and triangular, the dentigerous surface being broader than long. The pharyngeal teeth are slender, fine and cuspidate, and are arranged in about twenty rows.

Coloration. Unknown in life. The *preserved adult male* is dark brown above, rapidly shading to a light brass colour with an overall greyish tinge. Lips, lower jaw, horizontal limb of the preoperculum and the posterior opercular margin black. There is a very broad (*ca.* half diameter of eye) lachrymal band and two, narrow parallel bands across the snout. Dorsal fin yellowish-brown, the soft part faintly marbled. Caudal dark, anal with a narrow, yellow basal band but otherwise sooty, particularly in the area of the spines, except for a narrow and yellow distal margin.

Ecology. The only ecological information is that the fish was caught in *ca.* 10 feet of water over a mud bottom and near a fringing stand of swamp grass. The location is near Jinja and is in the relatively sheltered Napoleon Gulf.

Diagnosis and affinities. The species is characterized by the following combination of characters: pectorals long (35% of standard length and longer than the head), the third and fourth rays greatly produced; lower jaw flat and closing within the upper jaw.

Because of these particular characters, it is difficult to suggest possible relationships for the species. The elongate pectoral is, of course, a character which could easily and suddenly develop from the pectoral of any *Haplochromis.* The lower jaw, on the other hand, requires a more fundamental change and one rarely encountered in the Victoria species flock. It is otherwise found only in some of the larval fish-eating species (Greenwood, 1959). Certainly none of these could represent the ancestral or descendant condition of a species like *H. artaxerxes.* Without any knowledge of the skeleton in this species (and especially without more information on its dentition) little can be guessed about its phyletic position. Superficially, *H. artaxerxes* does resemble *H. estor* but it is immediately distinguished by the diagnostic characters listed above, and by its shorter head and lower jaw.

Haplochromis longirostris (Hilgen.) 1888

Text-figs. 10 and 11

Paratilapia longirostris Hilgendorf, 1888, *Sitzb. ges. naturf.-Fr. Berlin,* 77; Boulenger (part), 1915, *Cat. Afr. Fish.*, **3**, 332.
Haplochromis longirostris (part); Regan, 1922, *Proc. zool. Soc. Lond.*, 187, Pl. 4, fig. 2 (two of the three specimens described *loc. cit.*).
Haplochromis gracilicauda Regan, 1922, *op. cit.*, 188, Pl. 4, fig. 2.
Haplochromis tenuis Borodin, 1931. *Proc. New Eng. zool. Club.*, **12**, 50.

The characters which Regan used to separate *H. gracilicauda* from *H. longirostris* (snout $1\frac{1}{3}$ to $1\frac{2}{3}$ diameter of eye *cf.* snout $1\frac{2}{3}$ to twice diameter of eye) are really functions of growth, his species *H. gracilicauda* representing juvenile *H. longirostris.* Through the courtesy of Dr. K. Deckert of the Berlin Museum, I have been able to examine the holotype of *Paratilapia longirostris* (Z.M. Berlin Reg. No. 12744) and this confirms the identity of Regan's *H. longirostris* material. Two of these fishes (BM. [N.H.] Reg. No's. 1911.3.3.13 and 1906.5.30.516) are retained in the species but the third (B.M. [N.H.] 1906.5.30.274) is referred to *H. argenteus.*

Description based on twenty-nine specimens (including the holotype, and the syntypes of *H. gracilicauda*) 85–145 mm. S.L.

Depth of body 24·6–30·4 (M = 27·2) per cent of standard length, length of head 29·2–36·2 (M = 33·0) per cent. Dorsal head profile slightly concave or, less commonly, straight; sloping at an angle of *ca.* 30°. Premaxillary pedicels moderately prominent in large individuals.

Preorbital depth 18·2–22·5 (M = 20·8) per cent of head, least interorbital width 17·1–24·0 (M = 21·2) per cent. Snout length 32·0–38·6 (M = 36·0) per cent of head, 1·2–1·5 times as long as broad, narrowest in large fishes. Diameter of eye 18·8–24·3 (M = 21·7) per cent, depth of cheek 21·8–28·4 (M = 24·3) per cent.

Caudal peduncle 17·2–22·2 (M = 19·2) per cent of standard length, 1·7–2·3 (modal range 1·9–2·0) as long as deep.

Lower jaw markedly oblique, sloping at 40°–50°, its tip projecting slightly beyond the upper jaw in some fishes and level with it in others. Length of lower jaw 42·2–51·4 (M = 46·0) per cent of head, 2·4–3·3 times as long as broad. Lips slightly thickened, the median dentigerous part of the premaxilla not noticeably expanded. The posterior tip of the maxilla usually reaches the vertical from the posterior end of the premaxillary pedicels, or slightly beyond, but never reaches to below the anterior orbital margin.

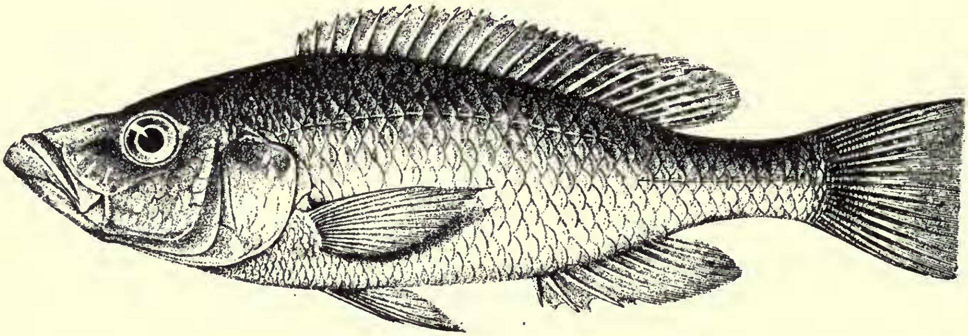

Fig. 10. *Haplochromis longirostris*, × N.S. (From Regan, *Proc. zool. Soc. Lond.*)

Gill rakers variable, from long and slender to short and stout, sometimes flattened and broadly branched ; 9–11 (rarely 8) rakers on the lower part of the first gill arch.

Scales ctenoid, lateral line with 32 (f.6), 33 (f.11) or 34 (f.12) scales, cheek with 3 or 4 rows. Five to 7 (mode 6) scales between the lateral line and the dorsal origin, 5–7 (mode 6), rarely 8, between the pectoral and pelvic fin bases.

Fins. Dorsal with 24 (f.4), 25 (f.19) or 26 (f.5) rays, comprising 15 (f.3), 16 (f.23) or 17 (f.2) spinous and 8 (f.4), 9 (f.18) or 10 (f.6) branched rays. The dorsal fin of the holotype is badly damaged and a count gives *ca.* 14, 9 rays. Anal fin with 11–13 rays comprising 3 spines and 8 or 9 (rarely 10) rays. Caudal truncate, scaled on its proximal two-thirds. Pectoral 20·8–25·2 (M = 23·0) per cent of standard length. First pelvic ray only slightly produced (not filamentous) in adult males.

Teeth. The *outer row* in both jaws is composed of slender and fine, moderately to strongly curved teeth, those situated posterolaterally in the upper jaw are almost hair-like. These outer teeth are unicuspid in most fishes, but in three (85·5 mm. and two of 111 mm. S.L.) there is a mixture of bi- and unicuspids or weakly bicuspids and unicuspids. There are 40–70 (M = 56) teeth in the upper jaw, the number showing no clear-cut correlation with standard length.

The *inner teeth* are either all unicuspid (fishes >125 mm S.L. and a few in the 95–

125 mm. range) or a mixture of uni- and tricuspids, unicuspids and weakly tricuspids or, as in the smallest fish (a syntype of *H. gracilicauda*), all tricuspids. The inner rows are implanted obliquely so that the teeth lie almost horizontally. There are usually 2 inner rows in the upper jaw (occasionally 3, rarely 1) and one or, less frequently, 2 in the lower jaw.

Osteology. The neurocranium barely differs from that of *H. mento* despite the more oblique angle of the lower jaw in *H. longirostris.* This greater jaw angle is apparently brought about by a slight difference in the articulatory surfaces of the quadrate and angular.

Vertebrae. 31 (f.7) or 32 (f.2) comprising 13 (f.1) or 14 (f.8) precaudal and 17 (f.6) or 18 (f.3) caudal elements.

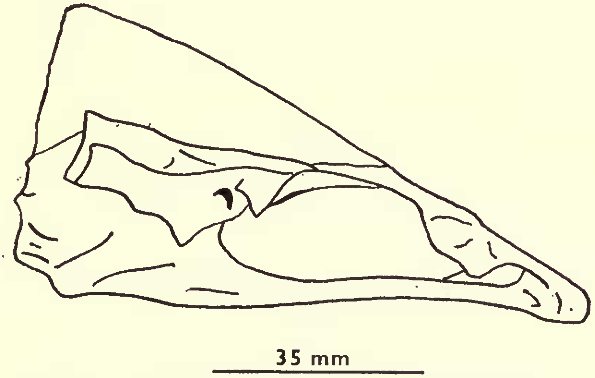

FIG. 11. *Haplochromis longirostris*, neurocranium.

Lower pharyngeal bone triangular, its dentigerous surface broader than long. The teeth are fine, cuspidate and compressed (those of the two median rows sometimes slightly enlarged) and arranged in 24–26 irregular rows.

Coloration. The colours of live fishes are unknown.

Preserved females are grey-brown above, silvery below with, on the flanks and belly, a slight brassy overtone. The lower lip and sometimes the mental area are sooty. All fins are hyaline, the dorsal with dark lappets and the caudal often densely and darkly maculate.

Sexually active males have an overall sooty appearance but with silvery areas showing through, particularly on the anterior flanks and the lateral aspects of the chest and belly ; the ventral parts of the chest and belly, however, are always darker than the dorsal parts of the body. The lower jaw, ventral part of the preoperculum and the branchiostegal membrane are intensely blank. Dorsal fin dark grey with black lappets and dark streaks between the soft rays. Caudal dark, especially on its proximal half. Anal dark, with a black area on the spinous part continued posteriorly as a narrow black band along the fin base ; the ocelli are barely visible as faint grey blotches. Pelvic fins black.

The amount of silver visible on the flanks may be correlated with the fish's state of sexual activity. *Juvenile males* are indistinguishable from females.

Distribution. Lake Victoria.

Ecology. Habitat. The species is known from only a few localities, each of which is a sandy beach either exposed to the open lake or within a sheltered gulf ; apparently *H. longirostris* is nowhere common.

Breeding. One female contains advanced embryos in the buccal cavity ; no other brooding fishes are known. Most individuals >110 mm. S.L. are sexually mature, as are some smaller fishes. Apparently both sexes reach the same maximum adult size.

Food. From the scanty data available, *H. longirostris* appears to feed on both insects (particularly pupal stages) and small fishes. Fourteen of the twenty-two specimens examined contained food. Eight had fed exclusively on insects, one on insects and fishes, and five on fishes only. The fish and insect remains were very fragmentary so identification could not be taken far. Only one fish could be identified (a small cyprinid, probably *Engraulicypris argenteus*) ; the insects are mainly pupal Bäetids.

Affinities. The slender, elongate body form and very oblique jaws of *H. longirostris* are immediate diagnostic characters and ones which isolate the species from all but one other in Lake Victoria. This other species is *H. argenteus*. *Haplochromis argenteus* differs from *H. longirostris* in having the jaws less oblique, the premaxilla more clearly " beaked " (i.e. the median toothed part expanded) and in having the eye diameter noticeably larger than the interorbital width.

On neurocranial characters, *H. longirostris* can be referred to the *H. mento* complex. But it differs from other species of this group in several character combinations and also in its mixed insect-fish diet. Phylogenetically, *H. longirostris* can be considered a somewhat isolated offshoot from the " *mento* "-group stem.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.262 (Paratype *H. gracilicauda*)	Bunjako	Degen
,, 1906.5.30.516	Bunjako	,,
,, 1906.5.30.268 (Lectotype *H. gracilicauda*)	Entebbe	,,
,, 1911.3.3.13	Jinja, Ripon Falls	Bayon
,, 1962.3.2.10–13	Jinja	E.A.F.R.O.
,, 1962.3.2.1	Grant Bay	,,
,, 1962.3.2.5	Karenia (near Jinja)	,,
,, 1962.3.2.14–25	Beach near Nasu Point	,,
	Tanganyika	
,, 1962.3.2.2	Majita Beach	,,
,, 1962.3.2.3–4	Mwanza, Capri Bay	,,
	Lake Victoria, Locality Unknown	
,, 1962.3.2.6–9		,,

Haplochromis mento Regan 1922

Text-figs. 12 and 25

Paratilapia longirostris (part) : Blgr., 1915, *Cat. Afr. Fish.*, **3**, 332, fig. 223.
Haplochromis mento Regan, 1922, *Proc. zool. Soc. Lond.*, 183.

Holotype. A specimen 174·0 mm. S.L., from Bunjako; B.M. (N.H.) Reg. No. 1906.5.30.258.

Description, based on twenty-five specimens (113–178 mm. S.L.) including the holotype.

Depth of body 24·1–31·5 (M = 28·9) per cent of standard length, length of head 31·5–37·1 (M = 34·5) per cent. There is some variation in the lateral outline of the head; in most specimens the head gives an impression of attenuation and of being pointed, but in others this impression is less marked and the head seems coarser and more bluntly rounded. There are no clear-cut morphometric differences between specimens belonging to either group, and intergrades exist.

Depth of preorbital 18·4–23·6 (M = 21·2) per cent of head, least interorbital width 20·4–24·4 (M. = 22·5) per cent. Snout 1·5–1·8 times as long as broad, its length 36·6–43·4 (M = 39·3) per cent of head; diameter of eye 16·8–22·0 (M = 19·2) per cent, depth of cheek 18·9–27·8 (M = 23·6) per cent.

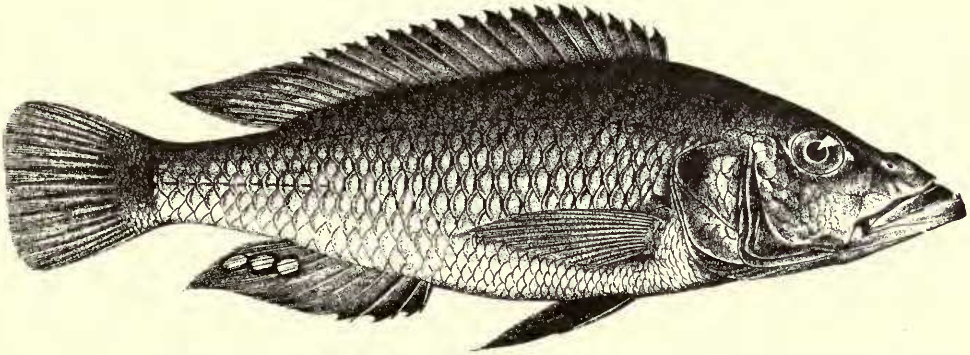

FIG. 12. *Haplochromis mento*; holotype, ·6 × N.S. (From Boulenger, *Fish. Nile.*)

Caudal peduncle length 14·1–20·9 (M = 17·5) per cent of standard length, 1·3–2·2 (modal range 1·7–1·8) times as long as deep.

Lower jaw projecting slightly in fishes <150 mm. S.L. and more markedly prominent in larger fishes; its length 41·8–50·0 (M = 46·8) per cent of head and 2·1–2·8 times as long as broad. Mouth slightly oblique or even horizontal, the medial dentigerous part of the premaxilla expanded anteroposteriorly. Posterior tip of the maxilla generally reaching to a vertical midway between the nostril and the anterior orbital margin, but sometimes extending a little more posteriorly.

Gill rakers short and stout, 8–10 (mode 9) on the lower part of the first arch, the lowermost 1–3 rakers reduced.

Scales ctenoid; lateral line with 32 (f.1), 33 (f.7), 34 (f.14) or 35 (f.3) scales, cheek with 3 or 4 (rarely 5) rows. Six or 7 (rarely 5) scales between the lateral line and the dorsal fin origin, 7 or 8 (rarely 9) between the pectoral and pelvic fin bases.

Fins. Dorsal with 23 (f.1), 24 (f.2), 25 (f.12) or 26 (f.10) rays, comprising 13 (f.1), 15 (f.5), 16 (f.18) or 17 (f.1) spinous and 8 (f.1), 9 (f.11), 10 (f.12) or 11 (f.1) branched rays. Anal with 11, 12 (mode) or 13 rays, comprising 3 (4 in one fish) spines and 8–10 rays. Pectoral fin 19·7–24·7 (M = 23·4) per cent of standard length. First pelvic ray produced in adult males. Caudal truncate, scaled on its basal half to two-thirds.

Teeth. The *outer row* in each jaw is composed of unicuspid, very strongly curved and moderately stout teeth, there being 38–66 (M = 52) in the upper jaw. The teeth of the *inner series* are predominantly unicuspids but in a few specimens there is an admixture of unicuspid and weakly tricuspid teeth. Teeth in the outermost row of the inner series, especially in the upper jaw, are often enlarged. All inner teeth are implanted at a very oblique angle. There are 2 or 3 (rarely 4) rows in the upper jaw and 2 (rarely 1 or 3) in the lower jaw.

Osteology. The neurocranium of *H. mento* presents no outstanding specific characteristics ; it is typical of the long, shallow and narrow skull found also in *H. macrognathus*, *H. estor*, *H. gowersi* and *H. dentex*. The premaxilla shows pronounced medial expansion, a character usually associated with the " *mento* " skull type but probably more marked in this species than in the others of the group.

Lower pharyngeal bone triangular, small and fine, its dentigerous surface broader than long. The teeth are cuspidate and generally fine but some of the median series may be coarser. The teeth are rather sparsely distributed and are arranged in 16 (rarely) to 20 (most common) rows.

Vertebrae. 30–32 (mode 30) comprising 13 or 14 precaudal and 17 or 18 caudal elements (7 specimens examined).

Coloration. Live fishes. Adult males have a steely grey-blue ground colour, darker (almost sooty) on the chest and belly, branchiostegal membrane dark grey. Snout, cheek and opercular region have an irridescent sheen. The spinous part of the dorsal is irridescent blue, the soft part dark neutral ; lappets dusky. Caudal fin dark neutral. Spinous part of the anal dusky, the soft part dark neutral and bearing the dull orange-red ocelli. Pelvics black on the outer third, the remainder of the fin dusky. The colours of *live females* and *immature males* are unknown but a recently dead female has the dorsal aspects of the body and head bright green and the flanks silver. All fins are yellowish neutral.

Preserved material. Sexually active males. Ground colour brownish with a sooty overlay on the belly, the branchiostegal membrane blackish-grey and a broad but indistinct lachrymal blotch. The dorsal fin is dark brown with black lappets. Caudal dark, densely maculate on its proximal two-thirds. Anal brownish to sooty-grey, the ocelli indistinct and greyish-brown. Pelvics black on the outer third, the remaining rays black but the intervening membrane light grey. *Quiescent males* have a female-type coloration (see below) except that the pelvics are sooty on the outer three rays, the branchiostegal membrane is dark and there are faint traces of grey-white ocelli on the anal fin. The vertical bars on the flank are not always visible. *Females* are brownish-grey above, becoming golden-silver below the level of the lower lateral line. There are about nine faint vertical bars on the flank and caudal peduncle ; each bar extends from slightly above the upper lateral line to a point some one to three scales below the level of the lower lateral line. The first five bars may be joined by a midlateral stripe of about the same width as the bars. The dorsal fin is colourless or light brown, the lappets dark. The anal, caudal and pelvic fins are yellowish brown to greyish.

Distribution. Lake Victoria.

Ecology. Habitat. Haplochromis mento is apparently confined to areas where the substrate is sand or sand and rocks, and where the water is not more than twenty feet deep. Most localities from which specimens were obtained are exposed but one is a sheltered gulf ; all are within two-hundred yards of the shore. the majority within one hundred yards.

Food. Eleven of the thirty-one specimens examined contained food in the stomach or intestines ; of these specimens, one had only the remains of a large dragonfly larva and the others only fish remains. It is regrettable that so few specimens contained food because the prey species are predominantly cyprinid fishes ; most other piscivorous *Haplochromis* seem to concentrate on cichlids. Of the ten specimens with fish in the guts, three had fed on Cichlidae (determined as *Haplochromis* in two cases) and seven on Cyprinidae (identified as *Engraulicypris argenteus* in two cases). Admittedly the contents of seven out of eleven stomachs is far too small a sample on which to base generalizations. However, it should be remembered that in samples of a like size from many other species, the identifiable food is entirely of cichlid origin and predominantly *Haplochromis*. Also, the eleven *H. mento* came from five different localities. Possibly, then, *H. mento* has specialized in preying on cyprinids, a group not heavily tapped by other piscivorous fish-predators (see Corbet, 1961).

Breeding. The species is a female mouth brooder. Fishes less than 135 mm. S.L. are immature. Possible sexual dimorphism in the maximum size attained cannot be determined from the sample available since few females are represented ; the three fishes of 170 mm. S.L. and over are all males.

Affinities. Structurally, *H. mento* is a specialized predator and, therefore, shows at least group affinity with *H. estor*, *H. gowersi* and *H. longirostris*. At this level there is also some affinity between *H. mento* and *H. macrognathus*, the latter being a structurally more extreme form of *H. mento*. The affinities of these two species are discussed on p. 174. *Haplochromis estor* and *H. gowersi* both differ from *H. mento* in several ways, but primarily in the shape of the head and the more oblique jaws of the former species. Thus, it is impossible to consider *H. mento* as having any close morpho-relatives, although the species does have phyletically close affinities with several others. Since *H. mento* shows the general characters of its specialized predatory line (particularly syncranial characters) it may represent a fairly basic anatomical state in that line.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.258 (Holotype)	Bunjako	Degen
,, 1962.3.2.179–191	Beach near Nasu Point	E.A.F.R.O.
,, 1962.3.2.192	Old Bukakata Bay	,,
,, 1962.3.2.193	Between Yempita and Busiri Isls. (Buvuma Channel)	,,
,, 1962.3.2.194	Jinja (below golf course)	,,
,, 1962.3.2.195	Grant Bay	,,
,, 1962.3.2.196–7	Kagera Port	,,

Museum and Reg. No.	Locality	Collector
	Uganda (continued)	
B.M. (N.H.).—1962.3.2.198–200	Entebbe (airport beach)	E.A.F.R.O.
,, 1962.3.2.206–7	Entebbe Harbour	,,
,, 1962.3.2.201–5	Bukafu Bay	,,
,, 1962.3.2.209	Thruston Bay	,,
,, 1962.3.2.210–1	Ramafuta Isl. (Buvuma Channel)	,,
,, 1962.3.2.212–7	Buka Bay	,,
	Tanganyika	
,, 1962.3.2.208	Beach near Majita	,,

Haplochromis mandibularis sp. nov.

Holotype. A specimen 140·0 mm. S.L., from Jinja; B.M. (N.H.) Reg. No. 1962.3.2.222.

Description based on ten specimens (131–174 mm. S.L.) including the holotype. Only one of these specimens is a female.

Depth of body 31·6–34·3 (M = 33·1) per cent of standard length, length of head 38·0–39·3 (M = 38·6) per cent; breadth of head immeditely anterior to orbits 22·4–28·3 (M = 25·9) per cent of head length. Dorsal profile of head sloping at an angle of 30°–40°, slightly curved and becoming concave in large fishes; premaxillary pedicels slightly prominent.

Preorbital depth 17·7–20·7 (M = 19·3) per cent of head, least interorbital width 19·6–22·2 (M = 21·2) per cent. Snout 1·5–1·8 times as long as broad, its length 36·2–39·7 (M = 38·6) per cent of head; diameter of eye 17·2–22·2 (M = 19·4) per cent, depth of cheek 24·5–29·2 (M = 26·1) per cent.

Caudal peduncle 12·2–15·2 (M = 14·2) per cent of standard length, 1·0–1·3 (mode) times as long as deep.

Mouth slightly oblique, lower jaw extension variable, from projecting markedly to no extension beyond the upper jaw. Lips somewhat thickened, the median toothed portion of the premaxilla only slightly expanded anteroposteriorly. The posterior tip of the maxilla reaches a point near the anterior orbital margin in most fishes, but it extends to the level of the orbit (or even slightly beyond) in a few specimens. Lower jaw 47·3–56·8 (M = 51·5) per cent of head, 2·0–2·9 (mode 2·5) times as long as broad.

Gill rakers short and stout, 8 (mode) or 9 on the lower part of the first arch, the lowermost 1 or 2 rakers reduced.

Scales ctenoid, lateral line with 32 (f.4) or 33 (f.6) scales, cheek with 4 (rarely 5) rows. Six or 7 scales between the lateral line and the dorsal fin origin, 6 or 7 (rarely 5) between the pectoral and pelvic bases.

Fins. Dorsal with 24 (f.1), 25 (f.8) or 26 (f.1) rays, comprising 15 (f.1) or 16 (f.9) spinous and 8 (f.1), 9 (f.7) or 10 (f.2) branched rays. Anal with 12 rays, comprising 3 spines and 9 branched rays. Pectoral fin 21·4–24·3 (M = 22·2) per cent of standard length. First pelvic ray somewhat produced and filamentous in adult males. Caudal truncate, the posterior margin running somewhat obliquely forwards and downwards; scaled on the proximal half to two-thirds.

Teeth. The *outer row* in both jaws is composed of fairly stout unicuspid teeth, recurved anteriorly and strongly incurved laterally ; there are 72–94 (M = 82) teeth in the upper jaw. The *inner teeth* are all unicuspid and obliquely implanted, being arranged in 4–6 rows in the upper jaw and 2 or 3 (rarely 4) in the lower jaw.

Osteology. The neurocranium closely approaches the *H. mento-macrognathus* type but is somewhat less extreme, particularly with regard to its anterior profile which is steeper. This gives the skull a stouter and more compact appearance. The premaxilla is as beaked as that of *H. macrognathus.*

Lower pharyngeal bone triangular, its dentigerous surface as long as it is broad, but with the posterior margin deeply indented in all specimens except the two largest. The teeth are fine, cuspidate and somewhat irregularly arranged in 20–24 rows.

Coloration. The live colours are unknown. A *preserved female* is brownish-grey above, shading to silvery-brown below. On the flanks are traces of about seven dark transverse bars and there is a very weak spot on the caudal fin base. The snout and upper jaw are dark grey, the lower jaw is paler. Dorsal fin hyaline but with sooty lappets and an oblique, ventrally directed dark bar on the soft part ; the base of the soft dorsal is dark. Caudal greyish-black, the basal half densely and darkly maculate. Pelvic and anal fins hyaline, the latter with one, faint, dead-white ocellus.

Quiescent males are brownish-grey above and on the snout and upper jaw, becoming silvery below. There is an interrupted midlateral black band from the posterior opercular margin to the caudal base, where it ends as a faint spot ; the spot may extend onto the caudal fin. There are also very faint traces of an interrupted dark band running immediately above the upper lateral line. The dorsal fin is hyaline but with dusky lappets and is densely maculate on the soft part. Anal hyaline, as is the caudal although the latter is densely maculate. Pelvics faintly dusky.

Sexually active males are dark brown above, brassy on the flanks, and black ventrally, particularly on the belly, chest and branchiostegal membrane. The lower part of the preoperculum and the lower third of the operculum are also black. The dorsal fin is dusky with black lappets ; the soft part is hyaline on the distal half and densely maculate proximally. The basal third of the caudal is dark brown or black, the distal part yellowish. The anal is yellowish with a narrow black basal band and a faint black area over the last two rays ; one or two dark ocelli are present. Pelvic fins are black.

Distribution. Lake Victoria.

Ecology. Habitat. The five localities from which *H. mandibularis* were obtained are all close inshore and have a hard sand substrate ; four are in sheltered areas and one is partly exposed. The maximum depth at which the specimens could have been living is between 20 and 25 feet

Food. Five of the ten specimens examined contained food. In each case the gut contents were fishes, identifiable as *Haplochromis* in two specimens and as cichlids in the other three.

Breeding. All the specimens are adult and only one (135 mm. S.L.) is a female. No other data are available.

Affinities and diagnosis. Superficially and in many morphometric characters, *H. mandibularis* resembles *H. macrognathus.* It is distinguishable, however, by the lack of a large, well-defined black spot at the base of the caudal fin, the lack of a black mental spot and by its deeper body. An obvious difference, but one which cannot be quantified, is the shape of the head which is less compressed and less acute in *H. mandibularis* ; also in this species, at least in the size-range available, the eye diameter is equal to or is slightly larger than the preorbital depth. In *H. macrognathus* of the same size (131–174 mm.) the preorbital is deeper than the eye. Anatomically and superficially *H. mandibularis* could represent the ancestral condition from which *H. macrognathus* evolved. *Haplochromis mandibularis* also shows relationship with *H. mento* but this is less intimate than that with *H. macrognathus* ; again the relationship is of a generalized to a more specialized species.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1962.3.2.222 (Holotype)	Jinja (below golf course)	E.A.F.R.O.
,, 1962.3.2.223–4	Jinja (below golf course)	,,
,, 1962.3.2.225	Jinja Pier	,,
,, 1962.3.2.226	Bugungu (opp. Jinja)	,,
,, 1962.3.2.227–8	Beach near Nasu Point	,,
	Lake Victoria, Locality Unknown	
,, 1962.3.2.229–230		,,

Haplochromis gowersi Trewavas, 1928

Text-figs. 13 and 14

Haplochromis gowersi Trewavas, 1928, *Ann. Mag. nat. Hist.* (10), **2**, 94.

Lectotype. A specimen 154·0 mm. S.L.; B.M. (N.H.) Reg. No. 1928.5.24.478.

Description based on twenty-two specimens (145–224 mm. S.L.), including the lecto- and paratypes.

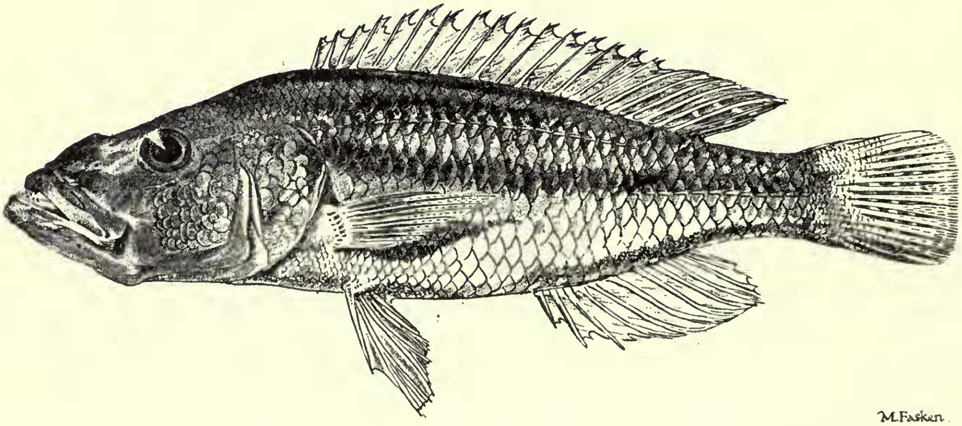

Fig. 13. *Haplochromis gowersi* ; type, ·68 × N.S. (Drawn by Miss M. Fasken.)

Depth of body 26·5–33·5 (M = 29·4) per cent of standard length, length of head 35·8–38·4 (M = 37·0) per cent. Dorsal head profile slightly curved, sloping at an angle of 30°–35°; premaxillary pedicels slightly prominent, but not sufficiently prominent to give a pronounced interorbital concavity to the profile.

Preorbital depth 19·3–24·0 (M = 22·0) per cent of head, least interorbital width 16·1–23·3 (M = 19·7) per cent. Snout 1·3–1·5 times as long as broad, its length 36·8–42·2 (M = 39·6) per cent of head; diameter of eye 15·5–19·3 (M = 17·5) per cent, depth of cheek 27·8–33·3 (M = 29·5) per cent.

Caudal peduncle 13·3–17·6 (M = 14·8) per cent of standard length, 1·3–1·6 (mode 1·4) times as long as deep.

Mouth oblique (sloping at *ca.* 30°–35°), lips slightly thickened, the median dentigerous surface of the premaxilla expanded anteroposteriorly; lower jaw always projecting but to a variable extent. Length of lower jaw 49·1–55·1 (M = 52·0) per cent of head, 2·1–2·7 times as long as broad. Posterior tip of the maxilla not reaching the vertical through the anterior orbital margin, usually reaching a point about midway between the nostril and the orbit, sometimes a little more posteriorly.

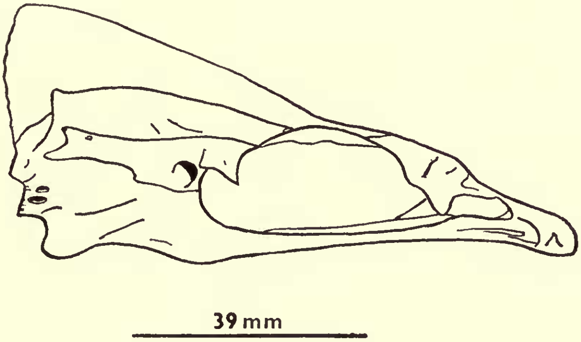

FIG. 14. *Haplochromis gowersi*, neurocranium.

Gill rakers short and stout, 8–10 (mode 9) on the lower part of the first gill arch.

Scales ctenoid; lateral line with 31 (f.3), 32 (f.2), 33 (f.8) or 34 (f.2) scales, cheek with 4 or 5 (rarely 6) rows. Six or 7 (less frequently 8) scales between the lateral line and the dorsal origin, 7 or 8 (rarely 5 or 6) between the pectoral and pelvic fin bases.

Fins. Dorsal with 24 (f.1), 25 (f.10) or 26 (f.9) rays, comprising 15 (f.7) or 16 (f.13) spinous and 9 (f.7), 10 (f.11) or 11 (f.2) branched rays. Anal with 12 or 13 rays, comprising 3 spines and 9 or 10 branched rays. Pectoral fin length very variable, 17·6–27·3 (M = 20·5) per cent of standard length. First pelvic ray slightly produced in adult males. Caudal truncate, scaled on its proximal third to half.

Teeth. The *outer row* in both jaws is composed of unicuspid, moderately stout and slightly to strongly curved teeth. There are 38–52 teeth in the upper jaw, the number showing a very slight positive correlation with standard length. The *inner teeth* are unicuspid and implanted obliquely; there are 3 or 4 (mode), rarely 5 rows in the upper jaw and 2 or 3 (rarely 4 or 5) in the lower jaw.

Osteology. The *neurocranium* of *H. gowersi* is virtually identical with that of *H. mento* and is thus similar to the neurocranium of *H. estor.*

Vertebrae. Twenty-nine or 30 (mode) in the six specimens examined, comprising 13 or 14 precaudal and 16 or 17 caudal elements.

Lower pharyngeal bone triangular, the dentigerous surface longer than broad, or, less frequently, as long as broad. The teeth are moderately stout and cuspidate, and are arranged in 18–20 slightly irregular rows.

Coloration is unknown in life. *Preserved females* have a silvery ground colour, darker dorsally and on the head. A prominent and fairly broad midlateral stripe runs from the opercular margin to the caudal origin ; a fainter, narrower and sometimes partly interrupted stripe runs above the upper lateral line. In some specimens there is a faint lachrymal stripe. All fins are hyaline, the soft dorsal and the caudal are densely maculate and the former has faintly sooty lappets. *Immature males* are coloured like females except that the pelvics are darker. *Sexually active males* have a dark brown ground colour, becoming sooty from below the lateral line, with a faint golden sheen on the flanks and lower part of the operculum. Midlateral and dorsolateral stripes are developed as in females. The branchiostegal membrane is black and there is a faint, dark lachrymal stripe. The dorsal and caudal fins are dark, the anal is yellowish, sometimes with a dusky overlay which does not extend to the distal margin. There are one to three large, greyish anal ocelli. The pelvic fins are black.

Distribution. Lake Victoria.

Ecology. Habitat. The species does not appear to be confined to any particular substrate, since it is caught over both soft (mud) and hard bottoms (sand, rock, shingle) ; it is found in exposed habitats (open beaches, off-shore islands) as well as in sheltered bays and gulfs. In no locality was the water more than 20 feet deep.

Breeding. One specimen (a female 153 mm. S.L.), from a sandy beach near the Kagera river mouth, had larvae in the buccal cavity. Sexual maturity is reached at a length of about 150 mm.

Food. All the fifteen specimens with food in the stomach or intestines had fed on fishes, but in two there was also a quantity of macerated plant tissue. The fish remains were identified as : *Haplochromis* (f.9), Cichlidae (f.4) ; unidentifiable (f.2).

Affinities. As Trewavas (1928) first suggested, *H. gowersi* has affinities with *H. mento.* It differs from *H. mento* in having a deeper cheek (mean depth 29·5% of head *cf.* 23·6%), a longer lower jaw (M = 52% of head *cf.* 46·8%) and a more oblique mouth.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.)—1928.5.24.478 (Lectotype)	Entebbe	Graham
B.M. (N.H.)—1928.5.24.479 (Paratype)	Entebbe	Graham
,, 1962.3.2.392	Williams Bay	E.A.F.R.O.
,, 1962.3.2.393–5	Beach near Nasu Point	,,
,, 1962.3.2.396–7	Karenia (near Jinja)	,,

Museum and Reg. No.	Locality	Collector
	Uganda (continued)	
B.M. (N.H.)—1962.3.2.398	Thruston Bay	E.A.F.R.O.
,, 1962.3.2.399–400	Kagera Port	,,
,, 1962.3.2.401–3	Buka Bay	,,
,, 1962.3.2.404–5	Bukassa	,,
,, 1962.3.2.406	Pilkington Bay	,,
,, 1962.3.2.407	Ramafuta Isl. (Buvuma Channel)	,,
,, 1962.3.2.409–415	Jinja Pier	,,
	Lake Victoria, Locality Unknown	
,, 1962.3.2.408		,,

Haplochromis macrognathus Regan 1922

Text-figs. 15 and 25

Paratilapia longirostris (part) : Blgr., 1915, *Cat. Afr. Fish.*, **3**, 332.
Haplochromis macrognathus Regan, 1922, *Proc. zool. Soc. London*, 182 ; Pl. 2, fig. 2.

Holotype. A specimen 160·0 mm. S.L.; from Bunjako. B.M. (N.H.) Reg. No. 1906.5.30.260.

Description based on twenty-three specimens (including the holotype) 80–174 mm. S.L.

Depth of body 26·6–33·3 (M = 30·7) per cent of standard length, length of head 33·8–41·4 (M = 38·2) per cent. Head noticeably compressed, its breadth (as measured immediately anterior to the orbital margin) 20·4–26·0 (M = 22·9) per cent of its length. Dorsal head profile straight or slightly curved, sloping at 25°–30° ; premaxillary pedicels moderately prominent and breaking the slope of the head as seen in profile.

Depth of preorbital 18·2–23·3 (M = 21·3) per cent of head, least interorbital width 16·5–22·2 (M = 18·6) per cent. Snout 1·5–2·2 times as long as broad (broadest in smaller fishes ; 1·5–1·6 times), its length 33·3–44·2 (M = 39·0) per cent of head, but with indications of weak positive allometry. Diameter of eye 16·1–24·1 (M = 18·5) per cent of head, slightly greater than, or equal to the preorbital depth in fishes 80–104 mm. S.L., less than the preorbital in larger individuals. Depth of cheek 24·2–31·2 (M = 27·0) per cent.

Caudal peduncle length 13·0–20·0 (M = 15·0) per cent of standard length, 1·1–1·8 (mode 1·4) times as long as deep.

Lower jaw projecting beyond the upper, variable in extent but generally more prominent in larger fishes, its length 48·1–58·8 (M = 54·0) per cent of head and 2·7–3·5 times as long as broad. Mouth moderately oblique, the lower jaw sloping at 25°–30° ; lips slightly thickened. The median dentigerous part of the premaxilla is greatly expanded anteroposteriorly so that in some specimens the premaxilla has a beak-like appearance. The posterior tip of the maxilla rarely reaches the vertical through the anterior orbital margin ; usually it extends to a vertical through the posterior tip of the premaxillary pedicels.

Gill rakers short and stout, 8 (mode) or 9, rarely 10 on the lower part of the first arch, the lowermost 1–3 rakers reduced.

Scales ctenoid ; lateral line with 30 (f.2), 31 (2), 32 (f.13) or 33 (f.6) scales, cheek with 3–5 (mode 4) rows. Six or 7 (rarely 8) scales between the lateral line and the dorsal origin, 6–8 between the pectoral and pelvic fin bases.

Fins. Dorsal with 24 (f.8), 25 (f.14) or 26 (f.1) rays, comprising 14 (f.1), 15 (f.19) or 16 (f.13) spines and 8 (f.3), 9 (f.13) or 10 (f.7) branched rays. Anal with 11 (f.3), 12 (f.18) or 13 (f.2) rays, comprising 3 spines and 8–10 branched rays. Pectoral 20·7–25·0 (M = 22·7) per cent of standard length. Pelvics with the first ray moderately produced in adult males. Caudal truncate, scaled on its proximal two-thirds, or, occasionally, as much as four-fifths.

Teeth. The *outer row* of teeth in fishes >100 mm. S.L. is composed entirely of stout, strongly curved unicuspids, but smaller fishes have an admixture of weakly bicuspid and unicuspid teeth. There are 50–100 (M = 80) teeth in the upper outer row. Teeth of the *inner series* in most fishes >110 mm. S.L. (but also in some between 95 and 100 mm.) are unicuspid ; in smaller fishes there is usually a mixture of uni- and tricuspid teeth, sometimes with one type predominating in one jaw but not in the other. All the inner teeth are implanted obliquely so that in the upper jaw their crowns lie almost horizontally. The number of inner tooth rows in the upper jaw shows some positive correlation with the fish's size, there being 3–6 (mode 5) for the size range available. No such correlation exists in the lower jaw where there are 2 or 3 (less commonly 1) rows.

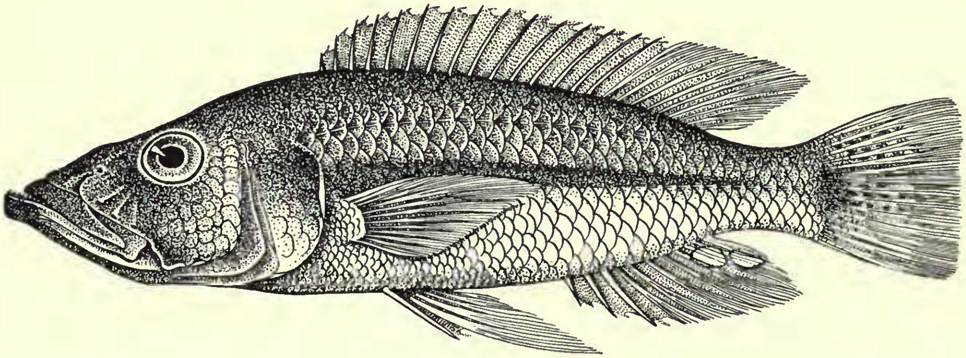

FIG. 15. *Haplochromis macrognathus*, holotype, .66 × N.S. (Drawn by Lavinia Beard.)

Osteology. The *neurocranium* is almost identical with that of *H. mento,* differing only in being slightly shallower and narrower, and in having the dorsal profile somewhat flatter. The premaxilla shows an extension of the trend seen in *H. mento* in that the median dentigerous section is greatly expanded anteroposteriorly and is almost beak-like.

Vertebrae. Twenty-nine or 30, comprising 13 or 14 precaudal and 16 or 17 caudal elements (5 specimens examined).

Lower pharyngeal bone. The outline is somewhat variable and is correlated with the head-shape of the fish. The dentigerous surface is triangular and usually equilateral but sometimes it is longer than broad, or, less frequently, broader than long.

The teeth are relatively fine (the two median rows somewhat coarser), are cuspidate and are densely crowded in 22 to 24 rows.

Coloration. The colour pattern of preserved females is a salient feature of the species, and is rare amongst Victoria *Haplochromis*. Nevertheless, it only represents the complete manifestation of the basic patterns shown in part by many species.

The colours of *live males* are unknown ; *females* are silvery-grey with a distinct midlateral black stripe on the flank and caudal peduncle, ending in a black blotch on the caudal fin near its base ; a very faint dark stripe runs slightly above the upper lateral line and there is a dark mental spot on the lower jaw. The chest is yellowish but the branchiostegal membrane is a dark saffron yellow. The dorsal fin is neutral but with dark spots and streaks between the rays. The upper half of the caudal is neutral and darkly maculate, the lower half is yellow. The anal fin is faintly yellow and the pelvics are saffron yellow.

Preserved material. Females. The ground colour is grey-brown dorsally, silver on the flanks and belly. A dark midlateral stripe runs from the eye to the caudal fin origin where it expands into a large blotch on the basal part of the fin ; the line is narrow on the head but widens shortly after it passes the posterior margin of the operculum. A second dark stripe runs slightly above the upper lateral line, from a point above the posterior opercular margin to the origin, or slightly beyond the origin of the caudal peduncle. At the base of the dorsal fin there is a series of dark spots which extend slightly upwards onto the fin membrane. There is usually a dark lachrymal spot, and always a dark blotch at the tip of the mandible. All fins, except the pelvics, are colourless although the dorsal and caudal may be darkly maculate. The pelvics are greyish, being darkest along their anterior margins.

Adult males. The ground colour is dark orange-brown. The stripes and other markings are as in females, with the addition of five or six rather faint transverse bars linking the two lateral stripes and extending a little below the lower stripe. The snout, lower jaw, branchiostegal membrane, lower limb of the preoperculum, lower part of the operculum, the chest and belly are black. The dorsal fin is sooty, the caudal dark and maculate. The anal has a black basal stripe which spreads diffusely out over most of the fin except for its distal margin which is yellowish-brown ; there are as many as six, irregularly arranged, blackish ocelli. The pelvics are black. Less sexually active males have a similar coloration but the pattern is not so intense, especially with regard to the black antero-ventral parts of the head and body.

Distribution. Lake Victoria.

Ecology. Habitat. The species has been recorded from three different habitats, viz.: sheltered gulfs with a hard substrate ; sheltered bays with a mud substrate ; and exposed, sandy beaches. From catch records it seems that *H. macrognathus* is commoner in areas where the bottom is hard than in places where it is muddy, and that the species does not occur at depths greater than twenty-five feet.

Food. Only five of the twenty specimens examined had ingested material in the stomach or intestines. Four of the five had fed exclusively on fish, and the fifth contained only fragments of plant tissue with attached colonies of blue-green algae (see also p. 144). The fish remains were identifiable in two cases as *Haplochromis*, in one as Cichlidae and in the fourth were too fragmentary for identification.

Breeding. *Haplochromis macrognathus* is a female mouth brooder. Most fishes <125 mm. S.L. are immature (one male 121 mm. S.L. was classified as " starting ") ; there is no sexual dimorphism in the maximum size attained.

Affinities. Anatomically, *Haplochromis macrognathus* belongs to the *H. mento-gowersi-estor* complex; but it is immediately distinguished from these species by the marked compression of the head and its almost beaked premaxillaries. The nearest living relative is, perhaps, *H. mandibularis* which although anatomically somewhat less specialized than *H. mento* shows certain characters (head compression, shape of mouth, coloration) strongly suggestive of the *H. macrognathus* condition.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.260 (Holotype)	Bunjako	Degen
,, 1962.3.2.420	Ekunu Bay	E.A.F.R.O.
,, 1962.3.2.421–5	Jinja Pier	,,
,, 1962.3.2.431–3	Jinja, below golf course	,,
,, 1962.3.2.434	Fielding Bay	,,
,, 1962.3.2.435	Pilkington Bay	,,
,, 1962.3.2.436	Entebbe, near Buganga	,,
,, 1962.3.2.437	Between Vempita and Busiri Isls. (Buvuma Channel)	,,
	Kenya	
,, 1962.3.2.418–9	Trawl S. of Port Southby	,,
	Tanganyika	
,, 1962.3.2.416–7	Beach near Majita	,,
,, 1962.3.2.426–430	Majita Beach	,,

Haplochromis pellegrini Regan 1922

Text-fig. 16

Paratilapia prognatha (part) : Blgr., 1915, *Cat. Afr. Fish.*, **3**, 333.
Haplochromis pellegrini Regan, 1922, *Proc. zool. Soc. Lond.*, 185, fig. 11.

Lectotype. A specimen 104·0 mm. S.L., from Entebbe, B.M. (N.H.) Reg. No. 1906.5.30.253.

Description based on twenty-five specimens (71–104 mm. S.L.) including the lecto- and paratypes.

Depth of body 29·0–33·6 (M = 31·1) per cent of standard length, length of head 34·6–37·9 (M = 36·3) per cent. Dorsal head profile sloping at *ca.* 30°, somewhat concave above the eyes, the premaxillary pedicels fairly prominent.

Depth of preorbital 15·4–22·2 (M = 17·7) per cent of head, least interorbital width 18·2–24·0 (M = 21·0) per cent. Snout longer than broad, its length 30·8–36·0 (M = 34·0) per cent of head ; diameter of eye 20·5–27·0 (M = 23·6) per cent, depth of cheek 21·4–27·0 (M = 24·3).

Caudal peduncle length 13·2–17·8 (M = 15·4) per cent of standard length, 1·1–1·5 (mode 1·3) times as long as deep.

Mouth moderately oblique; lower jaw sometimes projecting, its length 42·3–51·5 (M = 46·8) per cent of head, 1·7–2·4 (mode 2·0) times as long as broad. Posterior tip of the maxilla not reaching the vertical through the anterior orbital margin, but approaching this point in a few specimens. The median dentigerous part of the premaxilla slightly expanded anteroposteriorly.

Gill rakers moderately coarse, 7 (f.3), 8 (f.8), 9 (f.12) or 10 (f.1) on the lower part of the first arch, the lowermost 1–3 rakers reduced.

Scales ctenoid; lateral line with 30 (f.3), 31 (f.3), 32 (f.12) or 33 (f.7) scales, cheek with 3 or 4 (mode) rows; 6–8 scales between the lateral line and the dorsal fin origin, 6 or 7 (rarely 8) between the pectoral and pelvic fin bases.

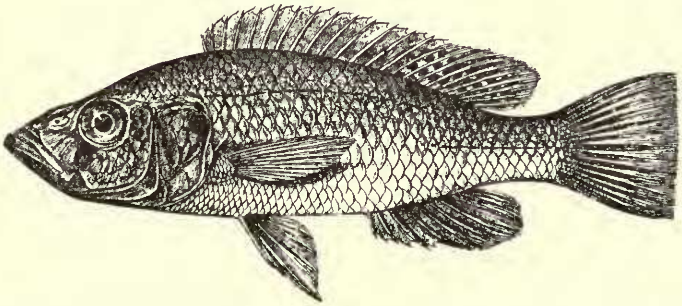

FIG. 16. *Haplochromis pellegrini*, lectotype, ·7 × N.S. (From Regan, *Proc. zool. Soc. Lond.*)

Fins. Dorsal with 23 (f.1), 24 (f.6), 25 (f.16) or 26 (f.2) rays, comprising 14 (f.5), 15 (f.13) or 16 (f.7) spinous and 9 (f.9), 10 (f.15) or 11 (f.1) branched rays. Anal with 3 spines and 8–10 (mode 9) branched rays. Pectoral fin 19·4–25·3 (M = 21·3) per cent of standard length. First ray of pelvic fin slightly produced in both sexes. Caudal truncate or subtruncate, scaled on its basal two-thirds.

Teeth. In most fishes <85 mm. S.L. the *outer row* is composed of weakly bicuspid and unicuspid teeth or only weakly bicuspids; in a few specimens this row may contain only unicuspids. Fishes >85 mm. have only unicuspid teeth in the outer row. All the outer teeth are slightly curved. The number of teeth in the upper jaw (44–62) shows slight positive correlation with standard length.

In the majority of specimens, all the *inner* teeth are tricuspid, but in some there is an admixture of tricuspids and weakly tricuspids. The inner teeth are arranged in 2 or 3 (rarely 4) rows in the upper jaw and 2 (rarely 1) in the lower.

Osteology. The neurocranium is similar to that of *H. bartoni* and *H. percoides* and does not closely approach the *H. guiarti* type. In other words it is of a type fairly advanced along the " extreme " predator line of evolution.

Lower pharyngeal bone triangular, its dentigerous surface broader than long. The teeth are fine and cuspidate, and are arranged in 22–24 rows.

Vertebrae. Twenty-eight or 29 (mode 28) comprising 13 precaudal and 15 (f.5) or 16 (f.3) caudal elements.

Coloration. Live females have a dark chocolate-brown ground colour, lighter on the chest and belly. All the fins are blackish-brown. The live colours of *males* are unknown.

Preserved material. Females. The ground colour is brownish-silver, grey on the upper surface of the head and above the upper lateral line. There is a distinct (if sometimes faint) lachrymal stripe and, in some specimens, traces of four incomplete and very faint dark vertical bars on the flanks ; the two anterior bars are crossed by a midlateral stripe originating behind the operculum but not extending beyond the first pair of bars. Dorsal fin greyish-black, as is the greater part of the caudal except for a narrow chevron of yellow-grey which extends forwards from the posterior margin. Anal greyish, pelvics yellow-brown with a sooty area at their base.

Males are uniformly dark brown, almost black, but the branchiostegal membrane is lighter ; the lachrymal stripe is very intense. The dorsal, caudal and anal fins are dark grey to sooty, the anal with two small elongate and dark ocelli. The pelvics are uniformly black except for a lighter innermost ray.

These notes are from specimens fixed in formol and preserved in alcohol. The two type specimens (both females) were fixed in alcohol and are light brown above the upper lateral line and bright silver on the flanks and belly. The dorsal fin is hyaline, with brown maculae on the basal third of the soft part. The caudal is also hyaline but is uniformly maculate. The anal and pelvic fins are colourless.

Distribution. Lake Victoria.

Ecology. Habitat. The material examined came from five localities all of which are relatively exposed sandy beaches near dense stands of submerged and emergent plants. The types came from Entebbe but no further details are known. If it is assumed that they were caught in native fishing gear (and, with regard to the date I think it reasonable to make this assumption) then the chances are greatly in favour of their having come from a similar habitat. Because of its small adult size, I cannot be certain that *H. pellegrini* does not occur in other habitats where fishing was carried out with large meshed gear (e.g. in many areas with a soft mud substrate). However, no specimens were caught in small-mesh trawls fished in these places.

Food. Of the thirty-five specimens examined, twenty-five had ingested material in the gut. In three fishes, this material was an unidentifiable sludge, in one there was sludge plus insect remains ; five had fed only on insects (principally Ephemeropteran pupae and larval Diptera) one on insects and small fishes, and fifteen had fed exclusively on fishes. The fish remains were very fragmentary but in most cases were identifiable as cichlids. The size range of the prey is 10–15 mm., that is immediately post-larval fishes. From these records it seems that *H. pellegrini* takes over from those predators which feed on embryo and larval cichlids (Greenwood, 1959). There appears to be some correlation between the diet of *H. pellegrini* and its habitat preference, since it occurs near areas where brooding cichlids congregate (e.g. reed beds).

Breeding. The species is a female mouth brooder. All the specimens seen are adults and both sexes reach the same maximum size.

Affinities. The body-form of *H. pellegrini* is similar to that of the *H. mento-H. gowersi* group and also *H. percoides.* The species is predominantly piscivorous but its small adult size is unusual for this trophic group. Anatomically it belongs to the group of moderately specialized fish-eaters, its neurocranium is fairly well advanced towards the grade of specialization shown by *H. estor* and *H. mento*, and again there is a strong resemblance to *H. percoides.* On skull and body form, *H. pellegrini* must be allocated to the group of moderately specialized predators, but there are no characters which allow one to assign it unequivocally to the *H. estor* complex or to the *H. percoides-flavipinnis* group.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.253 (Lectotype)	Entebbe	Degen
,, 1906.5.30.254 (Paratype)	Entebbe	Degen
,, 1962.3.2.510–2	Grant Bay	E.A.F.R.O.
,, 1962.3.2.513–5	Beach in Buvuma Channel	,,
,, 1962.3.2.509	Beach near Nasu Point	,,
,, 1962.3.2.516–44	Karenia (near Jinja)	,,

Haplochromis percoides Blgr. 1915

Text-figs. 17 and 25

Haplochromis percoides (part) Blgr., 1915, *Cat. Afr. Fish.*, **3**, 296, fig. 201 (the two syntypes only).
Haplochromis flavipinnis (part): Regan, 1922, *Proc. zool. Soc. Lond.*, 172 (the two syntypes of *H. percoides* only).

Lectotype. A male 79·0 mm. S.L., from Entebbe, B.M. (N.H.) Reg. No. 1906.5.30.313.

Description based on twenty specimens 67–93 mm. S.L., including the lecto- and paratype.

Depth of body 29·5–33·0 (M = 30·9) per cent of standard length, length of head 34·3–38·1 (M = 35·8) per cent. Dorsal head profile concave, the premaxillary pedicels prominent.

Preorbital depth 16·7–19·5 (M = 17·7) per cent of head, least interorbital width 19·2–22·8 (M = 20·7). Snout slightly longer than broad or as long as broad, its length 31·4–35·0 (M = 34·7) per cent of head; diameter of eye 21·9–26·6 (M = 24·2) per cent, depth of cheek 21·4–27·4 (M = 25·0).

Caudal peduncle length 12·9–16·4 (M = 15·3) per cent of standard length, 1·1–1·5 (modal range 1·4–1·5) times as long as deep.

Mouth slightly oblique, the jaws equal anteriorly or, more commonly, the lower projecting slightly. Length of lower jaw 42·3–49·2 (M = 45·2) per cent of head, 1·7–2·2 times as long as broad. Posterior tip of the maxilla close to or, occasionally, reaching the vertical through the anterior orbital margin.

Gill rakers usually slender, but in some specimens rather coarse and flat ; 7–9 (mode 8) on the lower part of the first arch.

Scales ctenoid ; lateral line with 30 (f.2), 31 (f.7), 32 (f.7), 33 (f.2) or 34 (f.1) scales, cheek with 3 or 4 (mode) usually imbricating but occasionally irregular rows. Six to 8 (mode 7) scales between the lateral line and the dorsal origin, 7 or 8 (rarely 6 or 9) between the pectoral and pelvic fin bases.

Fins. Dorsal with 22 (f.1), 23 (f.1), 24 (f.10), 25 (f.7) or 26 (f.1) rays, comprising 14 (f.2), 15 (f.12) or 16 (f.6) spines and 8 (f.4), 9 (f.10) or 10 (f.6) branched rays. Anal with 12 or 13 rays comprising 3 spines and 9 or 10 branched rays. Pectoral fin 22·4–26·6 (M = 24·4) per cent of standard length. First pelvic ray but slightly produced and then only in males. Caudal truncate, about the proximal half covered with small scales (*cf. H. flavipinnis*).

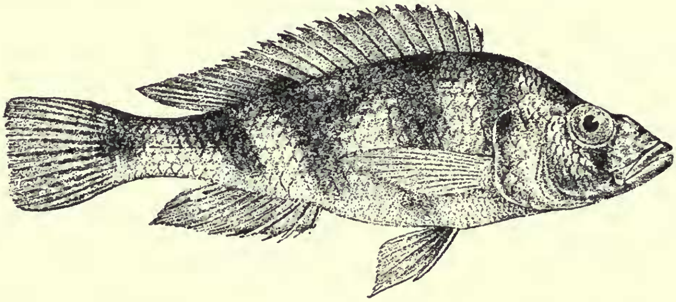

FIG. 17. *Haplochromis percoides*, lectotype ·94 × N.S. (From Boulenger, *Fish. Nile*).

Teeth in the *outer series* are predominantly unicuspid and slightly curved, but in some specimens of all sizes the lateral teeth are bi- or weakly bicuspid ; there are 44–56 (mean 50) outer teeth in the upper jaw. Except in one fish (91 mm. S.L.) the *inner series* of both jaws are composed of tricuspid teeth ; in the exceptional specimen all the inner teeth are unicuspid. There are 2 or 3 rows in the upper and 1 or 2 in the lower jaw.

Osteology. In its general form, the neurocranium of *H. percoides* is near that of *H. pellegrini*. The preotic face is long (67% of basal length) and its dorsal surface slopes at a gentle angle (*ca* 25°). The most noticeable difference is in the more depressed orbital region of the *H. percoides* neurocranium (reflected in the gentler slope of the dorsal surface). There is also a close resemblance between the neurocranium of *H. percoides* and that of *H. flavipinnis*. Again, the orbital region in *H. percoides* is more depressed.

The *lower pharyngeal bone* is triangular, its dentigerous surface broader than long. The teeth are slender, compressed and cuspidate, albeit weakly so in some of the anterior teeth. There are 18–22 rows of teeth.

Vertebrae. Twenty-nine, comprising 13 and 16 (f.7) or 12 and 17 (f.1) precaudal and caudal elements.

Coloration. The live colours of *H. percoides* are unknown, but judging from the well-marked vertical bands in all preserved specimens these must be conspicuous features in life. No marked sexual dimorphism is shown in the coloration of *preserved specimens,* except that the pelvic fins in males are black. The ground colour varies from silvery to dark brown ; there are five or six dark and broad transverse bands (extending from the dorsal fin base almost to the ventral midline) on the flank and caudal peduncle. Each of the two first and the two last bands are often linked by a narrow midlateral bar ; the last band frequently has a midlateral tongue extending onto the caudal fin base. Usually there are two transverse and parallel bars across the snout ; a lachrymal stripe of variable intensity is always present. The dorsal, caudal and anal fins are yellowish-orange and without other markings. The pectorals and pelvics are yellowish the latter variously dusky in males. Generally in males there is only one, ill-defined greyish blotch in the position of an anal ocellus.

Distribution. Lake Victoria.

Ecology. Habitat. The species is apparently restricted to shallow water over exposed or partly exposed sandy beaches. It is nowhere common but seems to be widely distributed around the lakeshore.

Food. Fourteen of the twenty specimens examined contained food, and all the identifiable remains were of fishes. In eight specimens the fish were small *Haplochromis* (*ca* 12 mm. S.L.), and in three the identification could not be carried beyond that of Cichlidae. In all the remaining specimens, the fish remains were too fragmentary for further identification. It was noticed that in five specimens the stomach contained four or five post-larval fishes of a similar size, thus suggesting that *H. percoides* may prey on shoals of young cichlids.

Breeding. No information is available on the breeding habits of this species. The sample studied consisted mainly of males and the only female showing signs of gonadial activity was a fish 78 mm. S.L.

Affinities. Haplochromis percoides occupies a rather isolated position amongst the Lake Victoria species, both with regard to its gross morphology and its colour pattern. The most closely related species is *H. flavipinnis.* The colour pattern of both species is virtually identical and both show a very concave upper head profile with pronounced nuchal hump. In *H. flavipinnis,* however, the jaws are inclined more steeply and the body is deeper. In details of neurocranial architecture, *H. percoides* shows a strong resemblance to *H. pellegrini* and it is conceivable that the latter species represents a stem type from which *H. percoides* evolved. There is little doubt that *H. flavipinnis* arose from an *H. percoides*-like ancestor.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.313 (Holotype)	Entebbe	Degen
,, 1962.3.2.345	Beach near Nasu Point	E.A.F.R.O.
,, 1962.3.2.346–53	Entebbe (airport beach)	,,
,, 1962.3.2.337–41	Entebbe Harbour	,,
	Tanganyika	
,, 1962.3.2.342–4	Beach near Majita	,,
,, 1962.3.2.332	Majita Beach	,,

Haplochromis flavipinnis (Blgr.) 1906

Text-figs. 18 and 19

Pelmatochromis flavipinnis Blgr., 1906, *Ann. Mag. nat. Hist.*, (7), **17**, 441 ; *Idem*, 1907, *Fish. Nile*, 448, pl. 89, fig. 3 ; *Idem*, 1915, *Cat. Afr. Fish.*, **3**, 418, fig. 286.

Haplochromis flavipinnis (part) : Regan, 1922, *Proc. zool. Soc. Londn.*, 172 (the type specimen only).

Holotype. A specimen 118·0 mm. S.L., from Bugonga ; B.M. (N.H.) Reg. No. 1906.5.30.308.

Description based on nineteen specimens (including the holotype), 69–156 mm. S.L.

Depth of body increasing allometrically with standard length, 30·8–39·2 per cent of the former. Length of head 33·6–38·0 (M = 35·8) per cent of standard length, dorsal profile concave, the concavity becoming more marked with increasing size.

Preorbital depth 16·7–21·8 (M = 19·5) per cent of head, least interorbital width 19·4–23·6 (M = 21·1) per cent. Snout as long as broad in most specimens but occasionally somewhat broader than long in fishes >130 mm. S.L. ; its length 29·2–36·4 (M = 33·3) per cent of head. Diameter of eye 19·0–25·0 (M = 21·8) per cent, depth of cheek (showing slight positive allometry) 25·0–32·7 per cent.

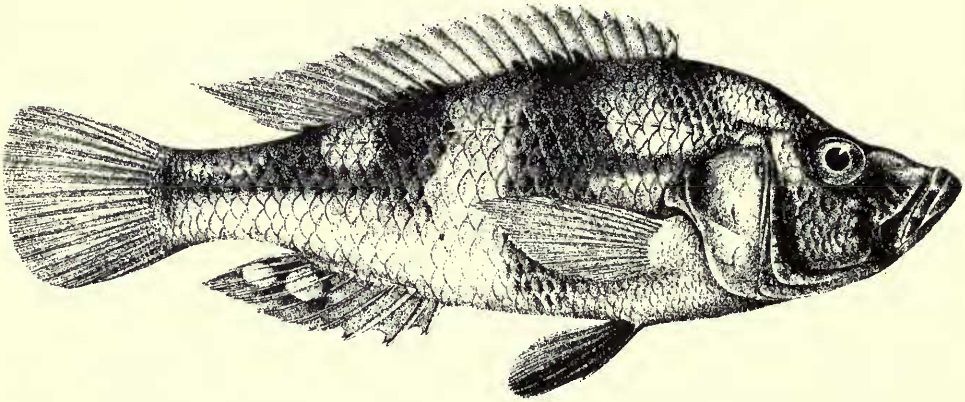

FIG. 18. *Haplochromis flavipinnis*, holotype, ·9 × N.S. (From Boulenger, *Fish. Nile.*)

Caudal peduncle length 13·8–18·6 (M = 16·0) per cent of standard length, 1·2–1·6 (modal range 1·2–1·4) times as long as deep.

Mouth oblique (sloping at 40°–50°), the lower jaw projecting slightly or, infrequently, the jaws equal anteriorly. Length of lower jaw 43·8–51·0 (M = 47·8) per cent of head, 1·6–2·0 times as long as broad. Posterior tip of the maxilla reaching or nearly reaching the vertical through the anterior orbital margin.

Gill rakers short and stout in fishes <90 mm. S.L., stout and flattened in larger individuals, 8 (mode) or 9, rarely 7 or 10, on the lower part of the first arch.

Scales ctenoid, the lateral line with 30 (f.2), 31 (f.5) 32 (f.10) or 33 (f.2) scales, cheek with 4 (mode) or 5, rarely 6 rows ; 7 or 7½ (less frequently 8) scales between the lateral line and the dorsal origin, 7 or 8 (less frequently 6) between the pectoral and pelvic fin bases.

Fins. Dorsal with 23 (f.1), 24 (f.12) or 25 (f.6) rays, comprising 15 (f.11) or 16 (f.8) spines and 8 (f.3) or 9 (f.16) branched rays. Anal with 11 (f.8) or 12 (f.11) rays, comprising 3 spines and 8 or 9 rays. Pectoral fin 23·2–29·6 (M = 25·6) per cent of standard length. Caudal fin obliquely truncate, the posterior margin sloping downwards and forwards to meet the somewhat curved ventral margin. In outline this fin resembles that of *H. plagiostoma* (see p. 200) but the lower rays do not have the appearance of regenerated structures. The caudal is truncate in the two smallest fishes examined (69 and 70 mm. S.L.) but is slightly oblique in a specimen 86 mm. S.L. At all sizes, the caudal is scaled over about two-thirds to four-fifths of its length, an unusually large area for a Lake Victoria species. The first pelvic ray is produced in adult males.

Teeth. The *outer row* of teeth in both jaws is composed of relatively slender, moderately curved unicuspids ; there are 44–66 (M = 55) teeth in the upper jaw, the number showing a very slight positive correlation with size in fishes <120 mm. S.L.

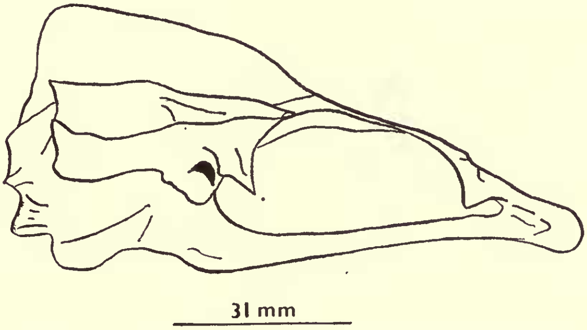

FIG. 19. *Haplochromis flavipinnis*, neurocranium.

The *inner rows* of teeth, in most individuals, are composed of unicuspids but in some fishes <100 mm. S.L. (and even in one of 150 mm.) these rows may contain a mixture of tricuspids, weakly tricuspids and unicuspids. There are 2 or 3 (less commonly 4) rows of teeth in the upper jaw and 1 or 2 rows in the lower.

Osteology. The neurocranium of *H. flavipinnis* resembles that of *H. percoides* in outline except for the shape of the supraoccipital and the points of divergence (slope of preorbital face, height in the interorbital region) are slight ; as in *H. percoides*, the neurocranium has a long preotic part (67% of basal length).

Vertebrae. Twenty-nine or 30, comprising 13 and 16 (f.6), 12 and 17 (f.2) or 14 and 16 (f.1) precaudal and caudal elements.

Lower pharyngeal bone triangular, the dentigerous surface slightly broader than long. The teeth are bicuspid and arranged in 18–20 rows, those of the two median rows are somewhat enlarged. In small fishes the teeth are relatively slender but are coarser in large individuals.

Coloration. The colours, and particularly the colour pattern, of *H. flavipinnis* are characteristic, even in preserved material.

Live colours. Adult males. Ground colour light silvery-orange dorsally, becoming greyish-black ventrally ; flanks and caudal peduncle crossed by four, broad, and dark bars. the two first becoming continuous with the dark ventral coloration. The snout and interorbital region are olivaceous, the cheek sooty ; anteriorly there is a broad-based, triangular lachrymal stripe. The dorsal fin is light olive-yellow, with dark, red-brown blotches between the soft rays. The caudal and anal fins are yellowish with an overall reddish brown tinge ; the anal ocelli are yellowish-red. Pelvic fins are black. *Adult females* have a light silver-yellow ground colour, but are dark, almost olive on the dorsal surface of the head. The body is crossed by four broad and irregular bars, the two anterior bars reaching further ventrally than the posterior pair. Dorsal fin dark neutral with darker spots on the soft part. The distal two-thirds of the caudal are dark, the proximal part is lighter. Anal fin yellow, the pelvics very light yellow except along the anterior margin where there is a brownish tinge.

Preserved material. Sexual dimorphism is less marked in fixed material, except that the chest and belly of sexually active males are dusky to black, and the entire pelvic fin is black. The ground colour is variable (probably dependent both on the fish's sexual condition if it is a male, and on preservation), from dark pinkish-brown to faintly orange-silver ; four, broad, dark and slightly irregular bars cross the flank and caudal peduncle, the two posterior bars do not extend much below the level of the lower lateral line, the two anterior bars extend (usually) almost to the ventral surface. The first and second bars are joined by a narrow midlateral stripe, as are the third and fourth bars ; from the latter there is often a posteriorly directed tongue which extends onto the base of the caudal fin. In many specimens the first three vertical bars extend upward onto the base of the dorsal fin and even part way up the fin membrane. The lachrymal stripe is a very characteristic feature, being a broad-based triangle which extends over almost half the cheek ; the remainder of the cheek is sometimes very dusky (perhaps a reflection of the fish's emotional state ?). The posterior margin of the preoperculum is outlined by a narrow vertical bar which merges dorsally with an anterior prolongation of the horizontal bar connecting the first two transverse flank bars. Often an obliquely directed, chevron-shaped interocular band is visible on the nape. The dorsal, caudal and anal fins are orange-pink or neutral, the soft dorsal maculate. In males there are three to five dead-white ocelli on the anal ; if there are more than three ocelli, they are usually arranged in two rows, the upper containing the greater number. In both sexes the pelvic spine and the first to third rays are blackish ; in sexually active males the entire fin is black.

Distribution. Lake Victoria.

Ecology. Habitat. It is impossible to generalize on the habitat preferences of *H. flavipinnis* from the data available. Specimens have been obtained from exposed sandy beaches, sheltered bays and gulfs where the substrate is of organic mud, and from rocky shelves running out from exposed islands. The only common factor in each locality has been the depth of water : less than twenty-five feet. Since *H. flavipinnis* is not abundant, nothing further could be determined.

Food. Ten of the eighteen specimens examined had food in the gut. Of these specimens, eight had fed exclusively on fishes and two contained fragments of Ephemeroptera in the stomach. The fish remains were too macerated for accurate identification beyond familial or generic levels ; in five guts the fish were identified as cichlids (and, since the scales were ctenoid, probably *Haplochromis*). No specimen had the remains of more than one fish in its stomach. The length of the prey species is estimated as ranging from 25–35 mm. S.L.

Breeding. No data are available on breeding habits. The sexes reach maturity at *ca.* 115 mm. S.L. and there is an indication that males may grow to a larger size than females.

Affinities. The coloration, and particularly the colour pattern, of *H. flavipinnis* serves as an immediate diagnostic character. It is not repeated in other Victoria *Haplochromis*. However, the transverse baring of *H. flavipinnis* is related to that of *H. percoides* (see p. 190). These two species are also related anatomically, although the jaws of *H. flavipinnis* slope more steeply and the caudal fin is obliquely truncated. Osteologically, the species show great similarity, particularly with regard to neurocranial architecture. The few differences (apart from coloration and caudal fin shape) which separate *H. flavipinnis* from *H. percoides* could be attributed to the larger adult size of *H. flavipinnis*, especially since the differences involve characters which often show differential growth rates.

Haplochromis flavipinnis also resembles *H. cavifrons*, at least anatomically, but again there are differences in coloration, in this case more marked than those between *H. percoides* and *H. flavipinnis*. The morphometric differences (e.g. the longer lower jaw and wider interorbital of *H. cavifrons*) are not correlated with size.

Phylogenetically, it seems probable that *H. flavipinnis* was derived from a small, inshore species like the present *H. percoides*, and that besides differences in coloration the evolution involved a differential growth of certain mouth-parts and associated neurocranial areas. That *H. flavipinnis* is less rigidly confined to a definite habitat may suggest that it is in the process of becoming an off-shore, mud-bottom species.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.308 (Holotype)	Bugonga	Degen
,, 1962.3.2.143–4	Ramafuta Isl. (Buvuma Channel)	E.A.F.R.O.
,, 1962.3.2.145–6	Jinja (below golf course)	,,
,, 1962.3.2.149–50	Jinja Pier	,,
,, 1962.3.2.154–5	Napoleon Gulf, near Jinja	,,
,, 1962.3.2.147	Ekunu Bay	,,
,, 1962.3.2.151–3	Entebbe Harbour	,,
,, 1962.3.2.156–8	Pilkington Bay	,,
	Tanganyika	
,, 1962.3.2.148	Majita Beach	,,
	Lake Victoria, Locality Unknown	
,, 1962.3.2.159		,,

Haplochromis cavifrons (Hilgend.) 1888

Text-figs. 20 and 21

Paratilapia cavifrons Hilgendorf, 1888, *Sitzb. Ges. nat. Fr. Berlin*, 77.
Pelmatochromis cavifrons: Blgr., 1915, *Cat. Afr. Fish.*, **3**, 419, fig. 287.
Haplochromis cavifrons: Regan, 1922, *Proc. zool. Soc. Lond.*, 183.

Description based on forty-one specimens, 108–195 mm. S.L.; I have not examined the type.

Depth of body 31·0–41·5 (M = 35·6) per cent of standard length, length of head 35·4–39·6 (M = 37·3) per cent. Dorsal head profile sloping at an angle of *ca* 30°, its outline sharply broken by the prominent premaxillary pedicels and thus appearing concave.

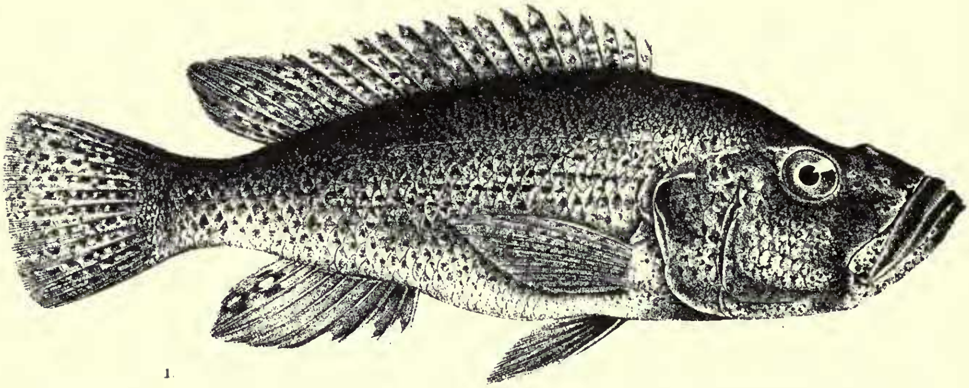

FIG. 20. *Haplochromis cavifrons*, ·75 × N.S. (From Boulenger, *Fish. Nile.*)

Preorbital depth 18·3–21·5 (M = 20·2) per cent of head, least interorbital width 21·5–27·5 (M = 25·4) per cent. Snout as long as broad, or slightly broader than long, occasionally somewhat longer than broad (the latter relationship is found most frequently in fishes <130 mm. S.L.); its length 34·0–40·0 (M = 36·5) per cent of head; diameter of eye 18·8–23·4 (M = 20·3) per cent, depth of cheek 27·2–35·4 (M = 30·2) per cent.

Caudal peduncle length 12·7–17·5 (M = 15·0) per cent of standard length, 1·0–1·4 (mode 1·3) times as long as deep.

Mouth oblique (35°–40°), the jaws equal anteriorly, or the lower projecting slightly. Lower jaw 49·3–60·5 (M = 55·5) per cent of head, its breadth contained 1·8–2·4 (mode 2·0) times in its length in fishes <175 mm. S.L., and 1·4–2·0 (mode 1·6) times in larger fishes. There is usually a broad mental projection developed at the mandibular symphysis. Posterior tip of the maxilla not reaching the vertical through the anterior orbital margin, and usually not covered by the preorbital.

Gill rakers short and stout 7 (rare)—10, mode 8, on the lower part of the first gill arch, the lowermost one or two rakers reduced.

Scales ctenoid; lateral line with 31 (f.6), 32 (f.18), 33 (f.14) or 34 (f.1) scales (in one specimen these scales are very irregularly arranged and give a count of 36); cheek with 4–6 (rarely 3) rows; 8–11 scales between the lateral line and the dorsal origin, 8 or 9 (less frequently 7 or 10) between the pectoral and pelvic fin bases.

Fins. Dorsal with 23 (f.1), 24 (f.14) or 25 (f.25) rays, comprising 15 (f.22) or 16 (f.18) spinous and 8 (f.4), 9 (f.27) or 10 (f.9) branched rays. Anal with 11 or 12 (rarely 13) rays, comprising 3 spines and 8, 9 (mode) or 10 branched rays. Pectoral 21·7–29·3 (M = 24·7) per cent of standard length. First pelvic ray slightly produced in adult males. Caudal truncate, scaled except for the distal quarter.

Teeth. The *outer row* in both jaws is composed of unicuspid, fairly stout and slightly curved teeth. There are 56–74 (M = 63) in this row of the upper jaw.

The *inner rows* in two of the five smallest specimens (108–129 mm. S.L.) are made up of uni- and tricuspid teeth, whilst in the three others and in fishes >130 mm. S.L. the inner teeth are all unicuspids. The inner rows are implanted obliquely, and there are 2–4 (rarely 1) rows in the upper jaw and 1 or 2 (occasionally 3) in the lower.

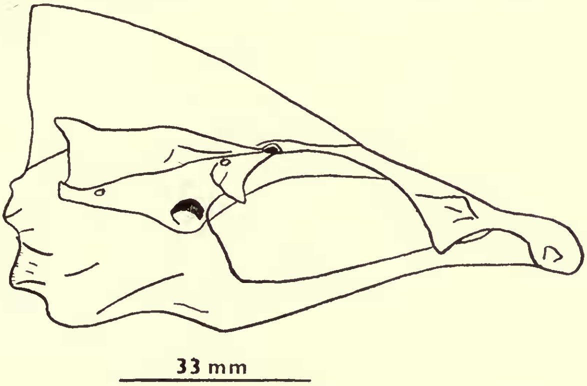

FIG. 21. *Haplochromis cavifrons*, neurocranium.

Osteology. The neurocranium is very similar to that of *H. flavipinnis*; that is, a moderately advanced type with the preorbital part sloping less steeply and the vomer not so markedly curved below the level of the parasphenoid as in the generalized forms.

Vertebrae. Twenty-nine (f.4) or 30 (f.1), comprising 13 precaudal and 16 or 17 caudal elements.

Lower pharyngeal bone triangular, the dentigerous surface as long as broad or slightly broader than long. The pharyngeal teeth are all basically bicuspid, but in larger fishes the minor cusp is vestigial except in the teeth which occupy the dorso-lateral corners of the bone. The teeth are somewhat irregularly arranged in about twenty rows.

Coloration. The densely freckled appearance of *H. cavifrons*, both alive and dead, is very characteristic. *Live colours. Adult males.* Ground colour olive to yellow-brown, shading to silvery below, the head dark brown. Both the head and body are densely speckled with brown spots and blotches. The dorsal fin is muddy yellow, sometimes (? in sexually active fishes) with traces of deep red mottling over its entire length. Caudal muddy-yellow with traces of deep red between the rays. Anal dark on its proximal third to half, muddy-red to pink distally; ocelli yellow. Pelvics are mottled black and pink, becoming blacker in sexually active males. *Females* have a similar coloration except that the pelvic and caudal fins are muddy yellow with dark blotches; the dorsal is like that of the male. Two aberrantly coloured females were caught near Mwanza (Tanganyika); in these fishes the ground colour is a dark olive green shading to light grey-green, the flecks darker green. The dorsal fin is mottled yellow-green, as is the caudal. The anal and pelvic fins are dark yellow with a faint green tinge.

Preserved material. Males. The ground colour is brown, varying from light bronze to a dark blackish-brown (in sexually active adults). The entire body and head are densely peppered with darker spots and blotches. The dorsal fin is dusky brown, marbled with darker pigment, especially on the spinous part. The caudal is brownish and faintly maculate. Anal fin light orange-brown, darker basally; ocelli faint, represented by one to three whitish spots. The pelvics are black in sexually active fishes, brownish in quiescent individuals.

Females have a similar coloration, but the ground colour is lighter and there are often traces of six, irregular and rather narrow transverse bars on the flanks and caudal peduncle. All fins, except the greyish pelvics, are as in males. One large female (190 mm. S.L.), still sexually active, has five white ocelli arranged in two rows on the anal fin.

Distribution. H. cavifrons is known definitely only from Lake Victoria; one of the specimens listed by Boulenger (1915) is from " Ripon Falls, Jinja " and may thus be from the Victoria Nile if it was caught *below* the falls.

Ecology. Habitat. It seems that *H. cavifrons* is essentially a " hard substrate " species since only two of the localities in which it was found had a mud substrate. Because the species is rare in catches from beach-operated seines, but relatively common in gill-nets set some hundred yards off-shore, it may be inferred that *H. cavifrons* is not a member of the inshore community as are, for example, *H. guiarti* and *H. bayoni*. No specimens were obtained from water more than 40 feet deep.

Food. Of the twenty-eight fishes (110–190 mm. S.L.) with ingested material in the gut, twenty-two had fed on fishes alone, two on fishes and insects and three on insects only. The insects eaten were: dragonfly larvae, chironomid larvae, and *Povilla* (Ephemeroptera) egg masses and larvae. In the individuals that had fed on fishes, the prey could be identified as follows: *Haplochromis* (f.15); Cichlidae of indeterminable genus (f.5); *Clarias* (f.1); indeterminable (f.1).

Breeding. No information was obtained on the breeding habits of *H. cavifrons*. Sexual maturity is reached in both sexes at lengths between 135 and 155 mm. S.L., and there is no dimorphism in the maximum size attained.

Affinities. No single character or combination of characters gives a clear-cut indication of the phyletic relationship of *H. cavifrons*. The coloration is unique and not easily derived from any other type now existing in the lake. Anatomically, the general suggestion is of relationships with *H. flavipinnis*, particularly with regard to head shape and mouth form. This suggestion is supported by the form of the neurocranium which is nearly identical in the two species. In turn, the same neurocranial characters associate *H. cavifrons* with *H. percoides*, a more generalized species than *H. flavipinnis*. But whereas *H. percoides* and *H. flavipinnis* have a related colour pattern, that of *H. cavifrons* is completely distinct.

It could be argued that similarity in neurocranial architecture is due to functional convergence. Against this it can be shown that similar oblique mouths and large jaws have been evolved in other species (e.g. *H. plagiostoma*) without producing a similar neurocranial shape. In fact, the neurocranium of *H. plagiostoma* is readily distinguished from that of *H. cavifrons*. If on these grounds convergence can be overruled, then *H. cavifrons* is possibly an isolated derivative from the *H. percoides* and *H. flavipinnis* stem.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.203–7	Bunjako	Degen
,, 1906.5.30.209	Buganga	,,
,, 1911.3.3.35	Jinja, Ripon Falls	Degen
,, 1962.3.2.358–65	Jinja	E.A.F.R.O.
,, 1962.3.2.354–5	Entebbe Harbour	,,
,, 1962.3.2.366–75 and 380–6	Ramafuta Isl. (Buvuma Channel)	,,
,, 1962.3.2.376–9	Pilkington Bay	,,
,, 1962.3.2.391	Bukarra (Sesse Isls.)	,,
	Kenya	
,, 1962.3.2.356	Naia Bay, Kavirondo Gulf	,,
	Tanganyika	
,, 1928.5.24.449	Mazinga Isl.	Graham
,, 1962.3.2.357	Mwanza	,,
	Lake Victoria, Locality Unknown	
,, 1962.3.2.388–90		E.A.F.R.O.

Haplochromis plagiostoma Regan 1922

Text-figs. 22 and 25

Paratilapia longirostris (part) : Boulenger, 1915, *Cat. Afr. Fish.*, **3**, 332.
Haplochromis plagiostoma Regan, 1922, *Proc. zool. Soc. Londn.*, 181, Text-fig. 8.

Holotype : a male 113·0 mm. S.L. from Bunjako, Uganda B.M. (N.H.) reg. no. 1906.5.30.261.

Description based on thirty specimens (including the holotype) 69–147 mm. S.L.

Depth of body 32·6–39·0 (M = 36·4) per cent of standard length, length of head 34·0–37·5 (M = 36·0) per cent. Dorsal profile of head gently concave or straight, sloping at an angle of 20°–25°.

Preorbital depth 18·0–21·5 (M = 19·8) per cent of head, least interorbital width 20·6–25·0 (M = 23·4) per cent. Snout slightly broader than long or as long as it is broad, its length 28·2–35·5 (M = 32·5) per cent of the head ; depth of cheek 28·0–36·8 (M = 33·0) per cent.

Caudal peduncle 13·2–18·5 (M = 15·8) per cent of standard length and 1·0–1·5 (modal range 1·2–1·3) times as long as deep.

Mouth markedly oblique, directed upwards at an angle of 35°–50° from the horizontal : jaws equal anteriorly or, occasionally, the lower projecting slightly ; length of lower jaw 44·0–54·5 (M = 49·2) per cent of head, 1·7–2·4 (mode 2·0) times as long as broad.

Gill rakers stout but occasionally rather slender, 8 or 9 (mode), less frequently 10, on the lower part of the first arch, the lowermost 1–3 rakers reduced.

Scales ctenoid, lateral line with 30 (f.8), 31 (f.5) 32 (f.12) or 33 (f.5) scales, cheek with 4 (mode) or 5, rarely 3, rows of scales ; 5–6½ scales between the lateral line and the dorsal origin, 6 or 7 (rarely 5 or 8) between the pectoral and pelvic fin bases.

Fins. Dorsal with 23 (f.4), 24 (f.18) or 25 (f.8) rays, comprising 14 (f.4), 15 (f.19) or 16 (f.7) spinous and 8 (f.6), 9 (f.18) or 10 (f.6) branched rays. Anal with 11, 12 or, rarely, 13 rays comprising 3 spines and 8 (mode), 9 or 10 branched rays. Pectoral fin shorter than the head, 24·6–31·0 (M = 28·1) per cent of standard length. Pelvics with the first branched ray produced, proportionately longer in adult males. The caudal fin of *H. plagiostoma* is obliquely truncate, the posterior margin sloping forward and downwards to meet the upwardly curved ventral margin. The fin shape is identical in both sexes and throughout the size range studied. The lower four or five principal rays in most specimens have the appearance of rays regenerated after damage ; commonly only one of the distal branches reaches the fin margin and sometimes neither branch extends much beyond the dichotomy. At present I cannot explain this peculiar fin shape, neither can I suggest whether it is due to some ontogenetic disturbance or to some behavioural trait of the species resulting in damage to the lower fin margin. Occasional specimens of other *Haplochromis* have an obliquely truncate caudal but *H. plagiostoma* and *H. flavipinnis* are the only species in which this peculiarity can be regarded as one of the specific characters.

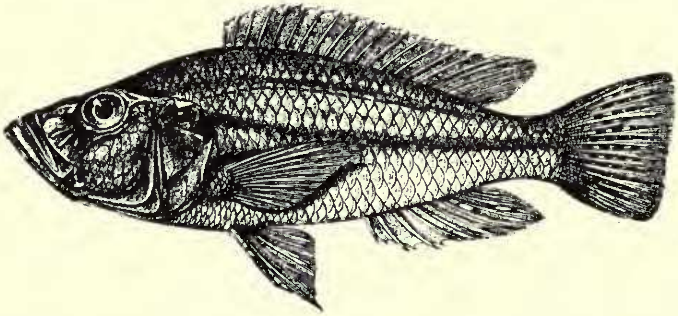

FIG. 22. *Haplochromis plagiostoma*, holotype, ·63 × N.S. (From Regan, *Proc. zool. Soc. Lond.*)

Teeth. Throughout the size range studied, the *outer row* in both jaws is composed of unicuspid, relatively stout and curved teeth, those of the upper jaw numbering 44–68 (M = 57) and somewhat more curved than the teeth of the lower jaw.

The inner rows are composed of unicuspids in all fishes >120 mm. S.L. and in some specimens in the range 70–120 mm.; other fishes in the latter size group have either all tricuspids or a mixture of uni- and tricuspid teeth. The inner teeth are arranged in 2 (less frequently 1) series in the upper jaw and 1 (less frequently 2) in the lower jaw. All these teeth are implanted obliquely, the angle sometimes approaching the horizontal.

Osteology. The neurocranium of *H. plagiostoma* is of the generalized *H. guiarti* type. Specifically, it differs from *H. guiarti* in having a slightly narrower interorbital distance and a shorter preotic region. Despite the marked difference in jaw angle of the two species (almost horizontal in *H. guiarti* and very oblique in *H. plagiostoma*) the interspecific differences in syncranial proportions and morphology are slight. The steep jaw angle is brought about by several minor changes. For example, the gentler slope of the ethmoid region (over which the premaxillary pedicels slide) allows the dentigerous area of the premaxilla to lie at a greater angle from the horizontal, thus matching the increased slope of the dentary. The latter gains its slope from slight changes in the articular surfaces of the quadrate and angular which allow the dentary to move dorsally through a wider arc than is the case in *H. guiarti.* There is also a compensatory change in neurocranial proportions. The preotic part of the skull in *H. plagiostoma* is relatively shorter than in *H. guiarti.* This shortening of the anterior part of the skull, correlated with a relatively longer dentary and more mobile hinge, allows the dorsal (i.e. most anterior part of the gape) to be moved from a position near the horizontal to one nearer the vertical. The lengthening of the lower jaw permits this change without causing any alteration in the near vertical angle of the hyomandibula.

The *lower pharyngeal bone* is triangular, its dentigerous area as long as broad or slightly longer than broad. The teeth are coarse and cuspidate, those of the two median rows being slightly enlarged ; there are 16–20 rows of teeth.

Vertebrae. Twenty-eight (f.1) or 29 (f.9), comprising 12 (f.2) or 13 (f.8) precaudal and 15 (f.1), 16 (f.7) or 17 (f.2) caudal elements.

Coloration in life. Sexually active males are light blue-grey on the flanks and postero-ventral surfaces, smokey grey dorsally and on the chest (which is darker than the back). The head is smokey-grey with lighter blue flecks on the cheek and operculum ; the branchiostegal membrane is sooty with a blue overlay. The dorsal fin is dark grey with deep crimson spots between the posterior spines and over the entire soft part ; the lappets and the margin of the soft dorsal are deep crimson. The caudal is dark with a crimson margin and spots on the proximal half. The anal is deep red, the ocelli (one to four arranged in a single row) yolk-yellow. The pelvics are black. In *quiescent males* the ground colour is more silvery, the dorsal fin less intensely coloured and the anal is hyaline except for a red flush which is most intense along the margin of the fin.

Females are silver with a faint powder-blue sheen posteriorly on the flanks and faint midlateral and dorsolateral stripes, the latter much shorter than the former.

Colour in preserved material. Females are brownish above, silvery below. There is a broad midlateral band, sometimes of irregular thickness, running from behind the operculum to the caudal origin ; a distinct but often faint lachrymal stripe is generally present. All the fins are hyaline but the caudal is densely maculate. *Sexually active males* are brownish above shading to a greyish copper on the flanks, and becoming sooty on the chest and belly ; the branchiostegal membrane is black. There is often a midlateral stripe but rarely are there any transverse bars ; a lachrymal stripe is usually visible. The dorsal, caudal and anal fins are brownish and sometimes faintly dusky. In some specimens there is a narrow black band on the dorsal fin, running obliquely backwards and downwards from the lappet of the last spine to about the middle of the last branched ray. The pelvics are black. The anal ocelli (1–4, usually 2) are opaque and are arranged in a single row.

Distribution. Lake Victoria.

Ecology. Habitat. The species has been caught over both soft (organic mud) and hard (sand and shingle) substrates. Common features of all localities are their sheltered nature (gulfs and bays) and relatively shallow depths (never more than 30 feet).

Food. Although *H. plagiostoma* is one of the commoner species, little is known about its feeding habits. The reason for this is the high frequency of fishes without food in the gut on capture. Those specimens with food (twenty-two in all) are exclusively piscivorous, the prey species being predominantly *Haplochromis* and, less often, small Cyprinidae (probably *Engraulicypris argenteus*). The two smallest fishes examined (81 and 91 mm. S.L.) had fed on fishes; the stomach of the smaller individual contained two post-larval *Haplochromis* (S.L., *ca.* 8 mm.).

Breeding. A single female (107 mm. S.L.) has been recorded with eggs in the mouth; this specimen is also the smallest sexually mature individual in the collection. One larger fish (115 mm. S.L.) is immature, but all other specimens 112 mm. S.L. and above are adult. Females may reach a larger size than males but I have insufficient material to confirm this point.

Affinities. No close relative of *H. plagiostoma* has been found amongst the present-day *Haplochromis* of Lake Victoria. The species is immediately characterized by its oblique mouth, obliquely truncated caudal fin and lack of distinct transverse bars on the body. Only one other species, *H. flavipinnis*, has an obliquely truncated caudal developed in all individuals, but its coloration is an obvious diagnostic character. An oblique mouth is not uncommon amongst the piscivorous species, but is usually associated with a different type of skull architecture than that of *H. plagiostoma*, which retains the basic *H. guiarti*-type. The nature of the neurocranium, the body-form and the male coloration all suggest that *H. plagiostoma* should be placed with the *H. victorianus*-*H. serranus* species-group, but representing an anatomically rather specialized offshoot. The other members of this group have typical subtruncate caudal fins and horizontal or slightly oblique mouths.

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1906.5.30.261 (Holotype)	Bunjako	Degen
,, 1962.3.2.438–9	Sesse Isls.	E.A.F.R.O.
,, 1962.3.2.440	Jinja (below golf course)	,,
,, 1962.3.2.446	Jinja, Pier	,,
,, 1962.3.2.441	Karenia (near Jinja)	,,
,, 1962.3.2.442	Buvuma Isl.	,,
,, 1962.3.2.443–5	Thruston Bay	,,
,, 1962.3.2.448–64	Pilkington Bay	,,
,, 1962.3.2.465–73	Ekunu Bay	,,
,, 1962.3.2.474–6	Buka Bay	,,
	Lake Victoria, Locality Unknown	
,, 1962.3.2.447		,,

Haplochromis michaeli Trewavas 1928

Text-figs. 23 and 24

Haplochromis michaeli Trewavas, 1928, *Ann. Mag. nat. Hist.*, (10), **2**, 93.

Note. I have already drawn attention (Greenwood, 1960) to a mistake over the identity of the two syntypes of *H. michaeli*. The two specimens which were thought to be the syntypes are actually referrable to a species now named *H. empodisma*. Before this error was realised, these specimens were used as the basis for comparison with other species. Thus, references to *H. michaeli* made in any of my papers published before 1960 should be corrected to read *H. empodisma*. I have no doubt about the identity of the specimens now considered to be the types of *H. michaeli*.

Lectotype. A specimen 145·0 mm. S.L., from Rusinga Island ; B.M. (N.H.) Reg. No. 1928.5.24.487.

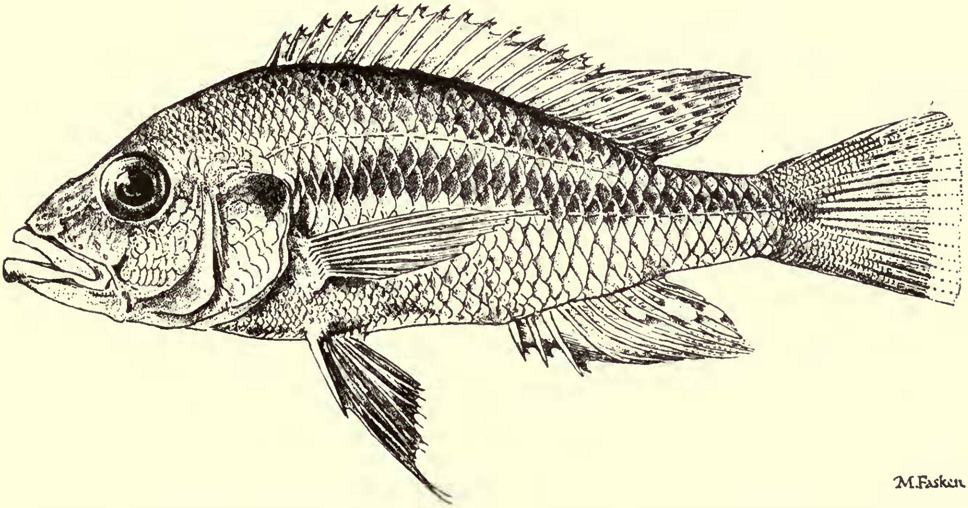

FIG. 23. *Haplochromis michaeli*, lectotype, ·7 × N.S. (Drawn by Miss M. Fasken.)

Description based on twenty-one specimens, 117–145 mm. S.L. (including the lecto- and paratype).

Depth of body 30·8–37·6 (M = 34·3) per cent of standard length, length of head 33·8–38·4 (M = 36·2) per cent. Dorsal head profile straight or slightly curved, if straight often with a gentle interorbital concavity.

Preorbital depth 14·8–19·2 (M = 17·4) per cent of head ; least interorbital width 24·8–29·4 (M = 26·6) per cent. Snout length 32·6–38·0 (M = 34·7) per cent of head, 1·0–1·2 times as long as broad ; diameter of eye 24·0–29·1 (M = 27·0), depth of cheek 22·9–27·7 (M = 25·8) per cent of head.

Caudal peduncle length 15·8–19·7 (M = 17·3) per cent of standard length, 1·3–1·9 (modal range 1·5–1·6) as long as deep.

Lower jaw slightly oblique, projecting a little in some specimens and always with a pronounced mental bump at the symphysis ; its length 43·3–53·5 (M = 48·0) per cent of head, 1·6–2·4 times as long as broad (modal range 1·8–2·0). Lips somewhat thickened, the posterior tip of the maxilla extending to below the pupil in most fishes but only to below the anterior part of the eye in others.

Gill rakers variable, from short but slender to short and stout ; 8–10 (mode 9) rakers on the lower part of the first gill arch.

Scales ctenoid ; lateral line with 31 (f.1), 32 (f.7), 33 (f.8), 34 (f.3) or 35 (f.2) scales, cheek with 3 or 4 rows. Six or 7 scales between the lateral line and the origin of the dorsal fin, 7 or 8 (rarely 6 or 9) between the pectoral and pelvic fin bases. The scales of the chest are noticeably small.

Fins. Dorsal with 24 (f.10), 25 (f.10) or 26 (f.1) rays, comprising 15 (f.19) or 16 (f.2) spinous and 9 (f.12), 10 (f.8) or 11 (f.1) branched rays. Anal with 11 (f.12), 12 (f.7) or 13 (f.1) rays, comprising 3 spines and 8 (f.12), 9 (f.7) or 10 (f.1) branched elements. In one specimen, only two spines are present in the anal. The caudal is truncate and scaled on its basal half to two-thirds. The first pelvic ray is slightly produced and filamentous in adult males. Pectoral fin 24·1–30·4 (M = 26·2) per cent of standard length.

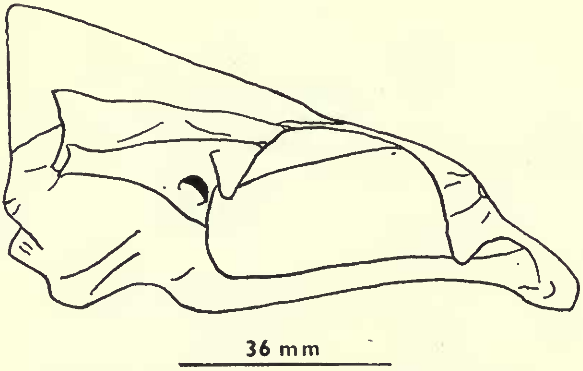

Fig. 24. *Haplochromis michaeli*, neurocranium.

Teeth. The *outer row* in each jaw is composed of slender, slightly curved and unicuspid teeth, of which there are 60–82 (M = 66) in the upper jaw.

The *inner teeth* are either all unicuspids or a mixture of uni- and weakly tricuspids ; there is apparently no correlation between the nature of the inner teeth and the size of the fish. In one exceptional specimen some of the inner teeth are bicuspid and the remainder are tricuspid. There are 3 (rarely 2 or 4) inner rows in the upper jaw and 2 or 3 (rarely 1) in the lower jaw.

Osteology. The *neurocranium* is of the generalized predator type and compares closely with *H. guiarti* or *H. serranus*. It differs from the generalized non-predator type (e.g. *H. brownae*) only in the somewhat more elongate preotic part of the skull (65% of basal length, *cf.* 55%) and consequently in the less steeply sloping dorsal profile. There is also an associated lengthening of the dentary as compared with *H. brownae*.

Vertebrae. Thirty (in all seven specimens examined), comprising 13 precaudal and 17 caudal elements.

Lower pharyngeal bone triangular, the dentigerous surface slightly to noticeably broader than long. The teeth are small, slender and cuspidate, occasionally with the two median rows composed of stouter teeth. The dental arrangement is irregular; the teeth are spaced and arranged in 22–24 rows.

Coloration. The colours of live fishes are unknown: *Preserved females* are brown above and yellowish below the well-defined, broad midlateral dark stripe. This stripe is often broken into two parts of variable length; it ends posteriorly at the base of the caudal fin. In some fishes there are traces of four, short and faint transverse bars on the flank; a dark lachrymal blotch is often present. All the fins are grey or greyish-yellow, the soft dorsal and the caudal are maculate.

Adult males are brown above the midlateral stripe and on the head; the stripe and occasional transverse bars are as in females, but the lachrymal marking is often in the form of a full stripe from the orbit to the angle of the jaws. Below the midlateral stripe, the colour is brassy-silver or greyish silver with the chest and ventral abdominal surfaces dusky, as is the branchiostegal membrane. All fins (except the pelvics) are sooty-brown, the dorsal with black lappets and darkened membrane between the branched rays. The caudal is maculate, the anal has a black patch across the spinous part and a black band along the distal margin of the fin. The anal ocelli (when present) are small and ill-defined black areas, four to five in number and arranged in a single line. The pelvics are black.

Distribution. Lake Victoria.

Ecology. Habitat. The species has been collected in only five different localities but in each the habitat was similar: a mud substrate in a sheltered gulf or bay, or, in the lee of a large island. The depth of water varied from 10–50 feet; all the specimens were caught in nets set on the bottom and within two-hundred yards of the shore. The exact locality at which the type specimens were collected is not known, nor have I been able to check the identity of specimens listed as *H. michaeli* in Graham's (1929) catch records; apparently these specimens are no longer in the Museum.

Food. Seven of the fourteen specimens examined contained food in the gut. Six of these had fed exclusively on fishes (unidentifiable); the other specimen had ingested large quantities of plant material, none of which showed signs of digestion.

Breeding. No data are available on the breeding habits of this species. The smallest fish (117 mm. S.L.) is immature and the next larger (127 mm.) is adult. The largest male is 138 mm. S.L. and the three largest specimens (141–145 mm.) are females.

Affinities. The nearest relative of *H. michaeli*, at least on anatomical grounds, is *H. martini* (see Greenwood, 1960). The external characters (excluding coloration) which separate the species are: the smaller eye of *H. michaeli* (24·0–29·1 (M = 27·0) of head *cf.* 29·4–37·5 (M = 31·7) per cent), its longer lower jaw (43·3–53·5 (M = 48·0) per cent of head, *cf.* 38·4–45·8 (M = 42·6) per cent), the predominance of unicuspid teeth in the outer row of both jaws (this row in larger *H. martini* [90–100 mm. S.L.] contains both bi- and unicuspids) and a less strongly decurved dorsal head profile. The yellow coloration of live and immediately *postmortem H. martini* is outstanding, and the *post mortem* colours of *H. michaeli* do not suggest any similarity. The preserved colour patterns of the two species are basically similar yet in *H. martini* an upper, interrupted lateral band is always present and the midlateral stripe rarely extends onto the caudal fin base as is usual in *H. michaeli*.

The morphological and anatomical differences between the species are slight and could well be the result of differential growth, particularly since the smallest specimen of *H. michaeli* is 13 mm. longer than the largest *H. martini*. As *H. martini* are sexually mature at a standard length of 80 mm. but *H. michaeli* are still immature at 117 mm. S.L., there can be little reason to suppose that " *H. michaeli* " specimens are merely large individuals of *H. martini*. But I do suggest that the species are very closely related and that *H. michaeli* evolved from an *H. martini*-like stem, one of its divergent characters (and biologically the most important) being the greater size attained. Like *H. martini*, *Haplochromis michaeli* represents a slight deviation from the generalized insectivore type and does not show any great anatomical specialization adapting it for its role as a piscivorous predator. The most obvious specialization *vis a vis* the generalized insectivore, is the larger gape and longer lower jaw, a character also developed in *H. martini*.

The resemblance between *H. michaeli* and *H. empodisma* is entirely superficial. The species belong to different phyletic lines, *H. michaeli* to one with only two extant species and *H. empodisma* to a longer line which includes the extant assemblage of mollusc-eating species (*H. pharyngomylus*, *H. ishmaeli* and *H. obtusidens* ; see Greenwood, 1960).

Study material and distribution records

Museum and Reg. No.	Locality	Collector
	Uganda	
B.M. (N.H.).—1962.3.2.314	Sesse Isls.	E.A.F.R.O.
,, 1962.3.2.315	Buvuma Isl.	,,
,, 1962.3.2.316–7	Fielding Bay	,,
,, 1962.3.2.318	Bugungu Bay (opp. Jinja)	,,
,, 1962.3.2.319	Ekunu Bay	,,
,, 1962.3.2.320–31	Pilkington Bay	,,
	Kenya	
,, 1928.5.24.487 (Lectotype)	Rusinga Isl.	Graham
,, 1928.5.24.488 (Paratype)	Rusinga Isl.	Graham

DISCUSSION

Evolution and Phylogeny

The piscivorous species form a large element of the Lake Victoria species-flock. I estimate that about 40 per cent of the known species are predominantly fish-eating. The specialized predators on embryo and larval fishes (Greenwood, 1959) are included in this estimate.

Like the majority of *Haplochromis* in the Lake, the predators probably evolved from one or two insectivorous species. There is no direct evidence to suggest that they evolved from an originally fluviatile piscivorous stem species. The present-day fluviatile predators are clearly more differentiated from the generalized *Haplochromis* than are the predatory *Haplochromis* of Lake Victoria. In fact, the most widely distributed species are placed in the genus *Serranochromis* which, despite its obviously close relationship to *Haplochromis*, is distinguishable from any predatory *Haplochromis* of Lake Victoria.

Within the Victoria species-flock there is one species, *H. brownae*, which seems to provide annectant feeding habits and certain anatomical details linking the generalized insectivores with the anatomically least specialized piscivores.

The anatomical characters involved in the evolution of the predator group are relatively simple and may be summarized as follows :

(i) An increase in adult size relative to species in other trophic groups ; the modal adult size-range for the species described here is 140–160 mm. S.L., whereas for the majority of non-piscivores it is 80–100 mm. Amongst the fish-eating predators there are exceptions to this generalization ; for example *H. percoides* and *H. pellegrini* with a modal adult length of 100 mm. Species showing the most specialized anatomical traits invariably belong to groups having the largest adult size-ranges.

(ii) A differential lengthening in the neurocranium. It appears that only the preotic region of the skull is involved in this relative growth. The changed proportions of the preotic skull are shown in the following figures. In adult non-piscivores of a generalized type (or even those with specialized feeding habits like algal-grazing) the preotic portion comprises some 55–58% of the neurocranial length. The proportion is probably affected by the adult size of the fish since in certain of the larger species (e.g. *H. ishmaeli*, a mollusc-crusher, or *H. empodisma* an insectivore) the preotic length is from 57 to 62% of neurocranial length. Intraspecifically it appears that there are insignificant ontogenetic changes in preotic proportion, at least over the latter part of the growth range. (e.g. in *Haplochromis mento* the preotic proportion in neurocrania of 25 and 30 mm. length is 66 and 67% respectively).

Amongst the piscivores the preotic proportion is from 62·0–71·0 (mean *ca.* 66·0) per cent, the figures being based on one adult neurocranium for each of the species described above except *H. artaxerxes*. Again, the differences in proportion cannot be entirely due to differences in neurocranial size. For example, the preotic is 71% in a 31 mm. neurocranium of *H. flavipinnis* but only 66% in a 38 mm. skull of *H. dentex*.

There are correlated changes in several syncranial characters. Two obvious changes are the relative lengthening of the lower jaw and deepening of the cheek region. The latter represents a general lengthening of the suspensorium and a broadening of the pterygoid bones ; it is used as a measure of these changes because it is easily determined by direct mensuration.

The lower jaw does not always lengthen in proportion to the lengthening of the preotic region, and the jaw may be relatively longer in one of two species with equal preotic proportions. In such a case, the lower jaw either projects beyond the upper or the suspensorium is greatly lengthened and the angle of the closed mouth becomes very oblique. The latter condition is seen in *H. plagiostoma* where the preotic proportion is 62% of the neurocranium, the lower jaw is 49% of the head length and the

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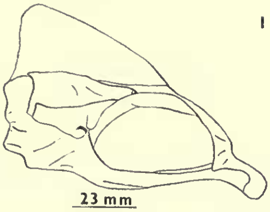

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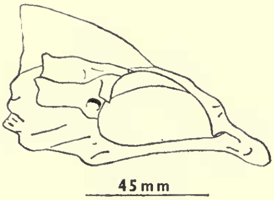

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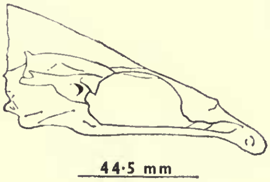

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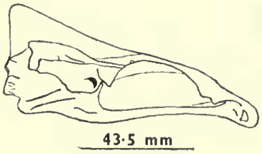

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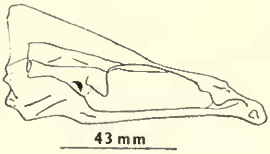

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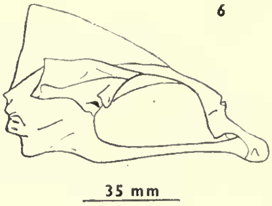

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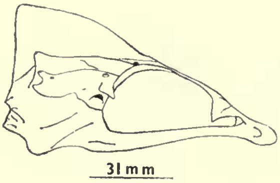

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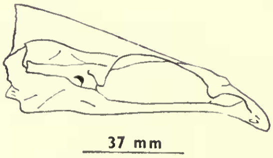

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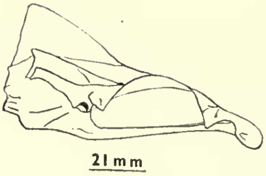

cheek is 33% of the head. These figures may be compared with *H. guiarti* (a species with a near horizontal mouth) where the preotic length is 65·5% of the neurocranium, the lower jaw 44·4% of the head length and the cheek only 25%.

(iii) Other changes in neurocranial proportions are a narrowing of the entire neurocranium and a decrease in its height, particularly of the otic-occipital region and the supraoccipital crest. Correlated with the decrease in height is a decrease in slope of the dorsal surface of the skull. This particular group of characters is not, however, a general one and many predatory species retain a skull whose outline (except for the longer preotic region) differs little from the generalized *Haplochromis* type. The slope of the dorsal surface, especially in the ethmoid region, affects the angle at which the premaxilla lies and hence the angle of the jaws. Species with a gently sloping ethmoid region tend to have the mouth more oblique than those with a steep ethmoid angle. Broadly associated with neurocranial outline is the body shape of the fish. Species with elongate, shallow neurocrania tend to have a slender elongate body shape, whilst the deeper bodied species have taller neurocrania.

(iv) A general character amongst the piscivores is the presence of unicuspid, curved and often strong teeth in the outer row of both jaws. However, in those species showing the greatest anatomical specialization, all or most of the teeth in small (i.e. juvenile) specimens are of the generalized bicuspid type. The pharyngeal teeth are generally few in number, moderately stout and with simple bicuspid or weakly bicuspid crowns. The oro-pharyngeal dentition as a whole is one adapted for gripping and macerating, not, as in many non-cichlid predators, merely for gripping the prey before it is bolted whole.

These, then, are the principal character complexes involved in the anatomical evolution of predatory species from a presumed insectivore stem.

In other morphological characters, such as the number of vertebrae, scales and fin rays, the piscivores do not differ from the generalized species. In this respect the Lake Victoria *Haplochromis* differ from those of Lake Nyasa. There, many species with a predatory facies and with piscivorous habits have more vertebrae and fin rays than do the generalized species. (I am indebted to Dr. E. Trewavas for giving me data on certain Nyasa species and for discussing this point with me).

FIG. 25. Diagram illustrating (in the left-hand column) the main evolutionary trend in neurocranial shape amongst the predatory species, from the generalized predator (1 and 2) to the "extreme" form (4 and 5). In the right-hand column, each neurocranium (except that of *H. guiarti*, No. 6) is a representative of the principal species or species group deviating from the major trend in other syncranial characters. *Haplochromis guiarti* represents a slight modification of the condition found in *H. brownae* (see text, p. 207).

All neurocrania are drawn to the same basal length; the actual length is shown below each specimen.

(1) *H. brownae*	(2) *H. serranus*	(3) *H. mento*
(4) *H. estor*	(5) *H. macrognathus*	(6) *H. guiarti*
(7) *H. plagiostoma*	(8) *H. dentex*	(9) *H. percoides*

Because this paper only deals with a representative sample of the Lake Victoria predators, it is not possible to discuss fully the phyletic relationship of the various species. When I have finished working on the other predatory species some clearer picture may emerge. At present a few supposedly phyletic groups can be recognized. Many species, although showing the broad characterization of either the " generalized predator " type (exemplified by *H. serranus*) or the " extreme predator " type (as seen in *H. macrognathus*), do not exhibit particularly close relationship with other living species. It is certainly more difficult to separate the predators into groups than it is to divide the non-predators into possible phyletic assemblages. One reason for this is, of course, the fact that the non-predators are divisible into phyletic-trophic groups on the basis of anatomical adaptations to a particular feeding habit. Convergence and parallelism do occur but are usually recognizable as affecting whole subgroups and not merely a single species. Amongst the predators the problem is complicated by the relatively few characters with which to build a group facies.

Despite such difficulties it does seem possible to reconstruct a putative ancestral type from which the base of the predator stem could have emerged. *Haplochromis brownae* may show the early stages of evolution leading from an insectivore towards a fully piscivorous predator. Anatomically, there are indications of some prospective adaptations for evolution in that direction. The mixed insect and small-fish diet is another important link. In most respects, however, *H. brownae* is very close to the extant and widespread, usually fluviatile species which we think must resemble the early colonizers of Lake Victoria.

From an *H. brownae*-like stem it is easy to imagine how the *H. serranus*, *H. victorianus*, *H. nyanzae* group was evolved. The species show some new characters (longer preotic skull, unicuspid teeth in the jaws) which may be the result of the larger adult size attained, but which may have evolved independently. Related to the *H. serranus* group is *H. plagiostoma*, an isolated species with very oblique jaws but a neurocranium of the type found in *H. serranus* and its allies.

Another " generalized " predator, but at a slightly higher level of differentiation, is *H. guiarti*. In this species the early stages in the development of an " extreme " predator type of neurocranium are still preserved, the body is more slender than in *H. brownae* and the adult size is greater. Yet, it is sometimes difficult to distinguish between young *H. guiarti* and adult *H. brownae* on the superficial characters of preserved specimens. Live colours, however, provide an immediate means of separating the species. *Haplochromis guiarti* may represent an ancestral type from which the " extreme " predator group (or groups) evolved, mainly by accentuation of the syncranial characters discussed above. The nearest advanced relative of *H. guiarti* appears to be *H. bayoni*, but the skull of this species is further developed towards that of the *H. mento* type.

For the moment it is difficult to suggest the relationships of such species as *H. bartoni*, *H. estor*, *H. dentex*, *H. longirostris*, *H. mento*, and *H. macrognathus*. All bear some resemblance to one another but this is not so close as that found in the non-predator groups (see Greenwood, 1956, 1957, 1960) or amongst the subgroups of larval-embryo fish-eating species. The situation may become more amenable to analysis when the status of species like *H. taeniatus*, *H. macrodon* and *H. prognathus* is fixed. *Haplochromis prognathus* could provide an indication of a stage in the evolution of the " extreme " species. The more basic ancestral stock of this group could, on present evidence, be either the *H. guiarti*-type or the *H. serranus*-type.

Two other predator groups are more easily defined. The smaller group contains only *H. martini* and *H. michaeli*. *Haplochromis martini* retains the appearance and anatomy of a generalized species yet it is partly piscivorous in its habits (see Greenwood, 1960). *Haplochromis michaeli* is little more than an enlarged version of *H. martini* with more definitely piscivorous habits.

The second group contains three species, *H. percoides*, *H. flavipinnis* and *H. cavifrons*, which show (in that order) progressive departure from the generalized stem towards a morphological type of their own. The group is characterized by the species having oblique jaws, concave dorsal head profiles, and unique colouring and colour patterns. The pattern and, to a lesser extent, the colours of *H. percoides* and *H. flavipinnis* are related but that of *H. cavifrons* is most distinctive and unrelated. On all available evidence I consider *H. percoides* and *H. flavipinnis* to be closely related, and *H. cavifrons* to be an independent derivative from the same stem. The neurocranium in these species shows departure from the *H. guiarti* type and resembles the neurocranium of the *H. bartoni*-*H. longirostris* type. On this character, as well as the general syncranial architecture, the *H. percoides*-*H. cavifrons* group might have evolved from a species resembling *Haplochromis pellegrini*. This is an intriguing species ; it is one of the smallest predominantly piscivorous forms and its syncranium is that of the more " advanced " predators.

None of the species considered in this paper shows close relationship with the larval and embryo fish-eating species (Greenwood, 1959), a group at least diphyletic in origin.

Feeding methods. In general the fish-eating *Haplochromis* macerate their food and do not swallow it whole as do the majority of non-cichlid piscivores. The pharyngeal teeth play a major part in this process, the oral dentition serving to hold the prey during maceration. Exceptions to this generalization are those species preying on larvae and embryos, and, occasionally, those species or individuals that prey on fishes less than 15 mm. S.L.

Because the water of Lake Victoria is so murky, direct observations on feeding habits cannot easily be made. The description which follows is based entirely on aquarium studies. The species involved were *H. gowersi* (two specimens each about 22 cms. total length) as predators and small *Tilapia esculenta* and *Haplochromis* spp. (40–70 mm. total length) as prey. Live food was introduced in the *H. gowersi* tank (4 × 3 × 3 feet) whenever it was available ; otherwise the predators were fed on chopped liver or mince-meat, a diet on which they did not thrive. For some minutes after the prey was introduced, the predator remained stationary or slowly aligned itself with the prey. Then it suddenly darted forward, inevitably catching the prey fish by the caudal peduncle. Never once did I see a frontal attack. The prey struggled for a short while but soon became motionless. The predator appeared to make no further attempt to swallow its food, although slight, almost trembling jaw and opercular movements were detectable. After four or five minutes (during which the predator might swim slowly forwards) the prey fish was released. The greater part of its caudal musculature had been grated away so that the terminal vertebrae and hypurals were exposed ; the caudal fin showed less signs of damage. At this stage the prey might attempt to swim off, but usually it remained motionless. The predator then either took hold of its prey from behind, and continued to rasp away the caudal region, or it positioned itself for a frontal attack. The latter course resulted in the head and fore-part of the prey being taken into the mouth. This, of course distorted the predator's mouth and branchial region and it gulped and " chewed " vigorously for some eight to ten minutes. At the end of that time only the prey's caudal fin protruded from the jaws. In all, the process of capture and ingestion took from fifteen to twenty minutes, a lengthy business and one destroying my preconceived notions (based on *H. gowersi's* anatomy and appearance) of a fast-moving rapacious predator.

Regrettably, I do not know whether these feeding methods are general or even natural. The fact that it is unusual to find more than one fish in a predator's stomach, even when the remains of that one individual are in a state of advanced digestion, suggests that the predators feed at fairly protracted intervals. Again, the usual occurrence in any one sample of less than fifty per cent of individuals with food in the stomach seems to reinforce the idea that feeding is not a process immediately triggered off by the digestion of the last meal. For comparison, it should be noted that a comparable sample of, say, mollusc-eating or insectivorous species, would yield about eighty per cent of specimens with food in the stomach.

Prey species. Because the food is so macerated it is difficult to identify the prey species with any degree of refinement. Piecing together what identifiable remains there are, it seems that the predators described in this paper feed mainly on other Cichlidae and to a lesser extent on small Cyprinidae, generally *Engraulicypris argenteus*. The identity of the cichlids is almost impossible to ascertain beyond the generic level. The most frequent stomach contents are of *Haplochromis* ; no definite remains of *Tilapia* are recorded but one cannot be certain that *Tilapia* are not represented amongst the numerous records of " unidentifiable cichlid remains ". Against the possibility of *Tilapia* being an important element in the diet, it must be stressed that predatory *Haplochromis* are rarely encountered in the habitats favoured by *Tilapia* of a size vulnerable to *Haplochromis*. For instance, by the time young *Tilapia esculenta* leave the reed-bed " nurseries " they are too large for all but the largest individuals of any fish-eating *Haplochromis* species.

SUMMARY

(1) Sixteeen species are redescribed on the basis of new material.

(2) In addition, five new species (*Haplochromis brownae, H. nyanzae, H. bartoni, H. artaxerxes* and *H. mandibularis*) are described.

(3) With one exception (*H. brownae*) all the species are piscivorous, the principal prey being *Haplochromis*. Small cyprinids also feature in the diet, and to a slight degree, various aquatic insects. Terrestrial insects may also be eaten when, after a heavy hatch, these fall into the water.

(4) Phyletic lines and groups are less clearly defined amongst the predators than in other trophic groups. Nevertheless three major groups can be recognized.

(5) The basic predator types are considered and the anatomical specializations of the others are described.

(6) One species, *H. brownae,* is thought to represent a transitional form (in habits and anatomy) between the generalized insectivore and the basic piscivore type.

(7) Some aquarium observations on the feeding routine of *H. gowersi* are summarized.

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PLATE I

Haplochromis victorianus : Natural size. Photograph of a specimen compared with *H. victorianus* holotype.